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NOTE ON THE CORK-COLORED ORANGE TORTRICID[1]

Platynota rostrana Walker

By E. R. SASSCER, *Bu. Entom. Dept. Agric., Washington, D. C.*

The Cork-Colored Orange Tortricid was first described by Walker[2] in 1863 from material collected in the United States and St. Domingo and Ega Hubbard in "Insects Affecting the Orange" gives a brief account of this insect in which he states that it is injurious to nursery plants and occasionally damages the fruit by puncturing the rind. Although the larvæ of this insect frequently bore into the rind of citrus fruits, no observations have as yet been made which would indicate that they enter the fleshy part of the fruit. From time to time letters have been received by the Bureau of Entomology, relative to the appearance of this pest in various sections of the country, but in only a few instances have they been reported as doing serious damage.

In February, 1909, Mr. Edward Gottfried of Key Largo, Fla., submitted grape fruit infested with this insect and subsequently gave a report on the conditions as they existed in his grove. According to his estimate fully 15 per cent of the fruit was damaged by the larvæ of this tortricid. In March of the same year, Dr. L. A. Peck of Melbourne, Fla., reported this insect present in his grove, stating that he had observed the punctures made by this pest for a number of years but had not hitherto seen the larvæ. After several failures in the attempt to rear the adult of this insect, the writer was finally suc-

[1] Published by permission of the Chief of the Bureau of Entomology.
[2] Cat. Brit. Mus. XXVIII, p. 290 (1863).

cessful in June, 1910. The material was submitted to Mr. August Busck who identified it as *Platynota rostrana* Walk.

The Cork-Colored Orange Tortricid is recorded as feeding on orange from St. George, Lake Bearsford, Enterprise, Ft. Ogden, Melbourne and Key Largo, Fla. In Columbia, Texas, it was found feeding on the flower buds and leaves of cotton by Dr. E. A. Schwarz and Mr. C. H. T. Townsend records it from Brownsville. The former has also collected the larva of this pest rolled in leaves of cotton at Bayou Sara, La., and it has been received from the same plant from Auburn, Ala. In 1885, Mr. J. W. Spencer of Sullivan County, Indiana, submitted corn infested with several pests, one of which proved to be *Platynota rostrana* Walk. The adult was reared by Mr. Theo. Pergande. This insect has also been collected at Kingston, Jamaica, by Mr. C. H. T. Townsend, feeding on the leaves of *Eucalyptus*. Aside from the localities previously mentioned, this comprises all the records in possession of the Bureau of Entomology.

The damage to fruit by this insect is quite similar to that caused by the orange tortrix, *Tortrix citrana* Fernald, which at times becomes of economic importance in certain sections of the citrus belt in Southern California. In a recent paper[1] Mr. H. J. Quayle describes the manner in which the larvæ of the latter burrow into the rind of the orange and, as is also the case with the cork-colored orange tortricid, they do not enter the fleshy part of the fruit. Fruit exhibiting the burrows of these insects is necessarily classed as culls and when discovered in the packing houses is thrown out as such. Furthermore, as stated by Mr. Quayle, these burrows form excellent places for the development of naval end rot, wither tip fungus and decay following blue mold.

THE LEOPARD MOTH AS A PEST OF APPLE NURSERY STOCK

By W. E. Britton, *State Entomologist, New Haven, Conn.*

In September, 1910, during the course of the work of inspecting the nurseries of Connecticut, in one large fruit tree nursery not far from the coast, some apples trees were noticed which had borers working in the stems or trunks, which at that time were perhaps about three fourths of an inch in diameter. The foreman stated that they had found and destroyed a number of similarly infested trees. Three or four of these trees were cut, the stems split, and a whitish grub

[1] Jour. Econ. Entom., Vol. III, no. 5, p. 401, Oct., 1910.

Leopard Moth

with black spots was found tunneling inside. The sections of the trees containing the borers were taken home to the laboratory, the split portions tied together, and the sticks planted end up in a flower pot of moist sand and covered with a lantern globe cage. The larva continued to feed until reaching maturity, and in due time pupated in the burrow. The insectary being heated, transformations took place much earlier than would be the case normally out of doors, and the adult emerged on February 25, 1911. It proved to be the leopard moth, *Zeuzera pyrina* Linn., and the accompanying illustration, Plate 8, shows the male on the end of the apple tree stem stretching and hardening his wings.

Though the leopard moth has long been known to attack all kinds of deciduous trees, it had not in my experience appeared as a pest of nursery stock. It is causing much damage to shade trees in the cities and towns near the coast, but attacks the smaller branches and twigs especially, often killing them in the tops of large trees. To the best of my knowledge this moth is not found far inland, but since its introduction into this country some thirty or more years ago, it has spread from the vicinity of Hoboken, New Jersey, where it was first noticed, according to Smith's list, north as far as Paterson and south to Eatontown. It has gone eastward and northward along the coast as far as the vicinity of Boston, where it has caused serious damage to shade trees. In Cambridge, Providence and New Haven much injury by it has been reported.

Most writers claim that two years are required for the leopard moth to complete its life cycle, but, though I have not followed the insect through its different stages, I have some evidence indicating one year as the period necessary to produce a generation. We hope to be able to make further observations to settle this point.

There is not much danger of disseminating the species in nursery stock, as the work of the larva is apparent at digging time, and the infested trees are ruined and unsalable.

SOME NOTES ON PARANDRA BRUNNEA FABR.

By A. B. Gahan

United States Bureau of Entomology, Bulletin 94, part 1, treating of damage to chestnut telephone poles by the Cerambycid borer, *Parandra brunnea* Fabr., records the fact that the first instance of serious injury of this nature to come to the notice of entomologists, was that of a case in Maryland which was investigated by the present writer.

The following brief notes are here given regarding the results of that investigation, as adding somewhat to the history of the first discovery of the insect in this relation, rather than as adding anything of much importance to the knowledge of the insect or its work, as contained in the bulletin mentioned.

The Entomological Department of the Maryland Experiment Station obtained its first knowledge of the insect through a letter dated November 30, 1906, from Mr. Clarence Kirwan, Right-of-way Agent of the Cheasapeake and Potomac Telephone Company in Baltimore, Md., who stated that it was doing serious damage to the company's poles at Annapolis. He sent also specimens of the larvæ and their work.

Not being able to identify the pest, and hoping to secure further information, the writer went to Annapolis, December 6, and, with with the help of the company's agent at that place, dug up the stub of one of the poles which had broken off at the surface of the ground, and beside which a new pole had been set. The stub was of chestnut, and the company's men were of the opinion that it had been treated with some kind of preservative before being placed in the ground, but this was not proven.

That the breaking of the pole had been induced by the work of these insects was evident, since in digging it up, no less than a dozen of the larvæ were uncovered in the partly rotten exterior wood, and examination showed the solid heartwood to be honeycombed with burrows which were tightly packed with castings. The greater number of the larvæ were located within a few inches of the surface of the ground, but several were found to have gone down to a depth of two feet below the surface. Most of the larvæ were in the outer layers of the wood but many had penetrated to a depth of three or four inches. Several other poles were examined and found to be infested, but none so badly as this one. The company's men reported that they had found the same insect in a number of other localities south of Annapolis, where it was causing considerable damage. One instance of unset poles, which had been lying on the ground at the roadside for a period of eighteen months being badly infested, was reported.

The stub of the broken pole was shipped to College Park, and placed in a breeding cage, the bottom of which had been covered with moist sand. Specimens of the larvæ and their work were submitted to Dr. A. D. Hopkins, who stated that he was unable to identify it at that time, further than that it was the larvæ of a Cerambycid.

Frequent examinations of the infested poles were made during the spring, summer and fall of 1907, but without finding adult beetles. In November of that year, the pole was cut into and larvæ were found

still feeding and without signs of pupation. During the winter and spring of 1908, the writer was engaged on other work, and compelled to neglect the notes on this borer. However, on July 9, the cage was again examined, and a single female beetle found beneath the pole. July 27 a male was taken from the cage, and another of the same sex, two days later. On August 17, another female was secured. No more adults appearing, the pole was later taken out, and split up, no larvæ or pupæ being found.

While incomplete, these records show that the life cycle of this beetle extends over a period of at least two years, and more likely three years are occupied in its various transformations.

LOCOMOTION OF CERTAIN YOUNG SCALE INSECTS

By H. J. Quayle

The object of this paper is to present a few experiments on the powers of locomotion of the Black Scale (*Saissetia oleæ* Bern.), the Red or Orange Scale (*Chrysomphalus aurantii* Mask.) and the Purple Scale (*Lepidosaphes beckii* Newm.). These three scales represent the most important insect enemies of citrus trees in southern California, and the question of how they are spread and what part their own powers of locomotion play in the matter frequently come up for discussion.

The distribution of scale insects over long distances is effected mainly through the interchange of nursery stock, and over the same general community by birds and active insects, chiefly, together with the agency of man in his usual cultural operations, while in the spread from tree to tree or to nearby trees, aside from the above factors, the power of the insects to transport themselves must be taken into consideration. The wind is another factor which may aid certain insects in distributing themselves, either by blowing them directly or with a leaf or light twig upon which they may be resting. Such insects as winged plant lice or the males of scale insects have frequently been observed to be wafted by a gentle breeze or aided in their flight through its influence. Experiments with a foot bellows showed that young black scales are not very readily dislodged from a twig, but once dislodged might be carried a short distance as they fell. Twigs having numerous active young scales had to be brought to within about six inches of the mouth of the bellows before any of the insects were dislodged. It thus requires a stronger wind than

usually blows to have any effect on the scales on the tree, but once dislodged the wind might carry them to an adjoining tree if the foliage of the different trees were in close proximity.

Rate of Travel Over Smooth Paper

In order to determine the maximum distance that young scale insects would travel under the most favorable conditions, accurate records were made of the movement of the insects over smooth paper for two-hour periods. Tracings representing their actual movements were made on large sheets of paper and will be reproduced in a later publication. Tabulation of the data is given in the accompanying table. It will be seen that temperature has a very great influence on the activity of the insects. The minimum temperature of 73.5° F. on which records were made for the black scale shows a maximum distance traveled of 81 inches with an average of 71.5 inches, while with a temperature of 90° F. the maximum distance traveled was 180 inches with an average of 151 1-3 inches. It thus appears that an active young black scale will travel more than twice as far upon a raise in temperature from 70° to 90° F.

The influence of temperature is similarly shown in the case of the red scale. At a temperature of 66° the maximum distance traveled was 41 inches, while with a temperature of 91° the maximum distance

RATE OF TRAVEL OVER SMOOTH PAPER

Black Scale (*Saissetia oleæ* Bern.)

Exp. No.	Date	Time	Temp.	Distance	Av. Distance
1	Nov. 2, 1910.....	1.45–3.45 p. m.	73.5 F.	70 in.	
1	Nov. 2, 1910.....	1.45–3.45 p. m.	73.5	62 "	
1	Nov. 2, 1910.....	1.45–3.45 p. m.	73.5	81 "	71.5 in.
2	July 5, 1910.....	2.15–4.15 p. m.	80	73 "	
2	July 5, 1910.....	2.15–4.15 p. m.	80	80 "	76.5 in.
3	Aug. 17, 1910.....	9.30–11.30 a. m.	83	103 "	
3	Aug. 17, 1910.....	9.30–11.30 a. m.	83	140 "	
3	Aug. 17, 1910.....	9.30–11.30 a. m.	83	127 "	123.33 in.
4	July 19, 1910.....	2.15–4.15 p. m.	90	108 "	
4	July 19, 1910.....	2.15–4.15 p. m.	90	166 "	
4	July 19, 1910.....	2.15–4.15 p. m.	90	180 "	151.33 in.

Red Scale (*Chrysomphalus aurantii* Mask.)

5	Dec. 6, 1909.....	2.20–4.20 p. m.	66	41 "	
5	Dec. 6, 1909.....	2.20–4.20 p. m.	66	25.5 "	
5	Dec. 6, 1909.....	2.20–4.20 p. m.	66	34 "	
5	Dec. 6, 1909.....	2.20–4.20 p. m.	66	23 "	31.12 in.
6	July 20, 1910.....	2.35–4.35 p. m.	91	111 "	111 in.

Purple Scale (*Lepidosaphes beckii* Newm.)

7	Nov. 18, 1910.....	9.20–12.20 a. m.	62	9 "	
7	Nov. 18, 1910.....	9.20–12.20 a. m.	62	21 "	
7	Nov. 18, 1910.....	9.20–12.20 a. m.	62	27.5 "	19.16 in.
8	Nov. 3, 1910.....	2.10–4.10 p. m.	68	37.75 "	
8	Nov. 3, 1910.....	2.10–4.10 p. m.	68	28 "	32.87 in.
9	July 21, 1910.....	1.20–3.20 p. m.	89	111 "	111 in.

traveled in the two-hour period was 111 inches. In most cases these experiments started off with four insects but some would be lost or destroyed, so that completed records are given for but one in some instances. But since it was more desirable to have the maximum rate of travel in each case, one record, in the case of the higher temperatures, answers the purpose. With the purple scale the maximum distance traveled was 37.95 inches when the temperature was 68° and a total of 111 or more than three times the distance when the temperature was 89°.

Taking the maximum life of the active larva of each of these scales at 4 days, which seems from our experiments to be about correct, the possible maximum distance traveled during the period may be calculated. For the black scale the maximum rate of crawling for a two-hour period is 15 feet. If it continued at this rate without stopping for 4 days it would travel a total of 720 feet, but this is never actually done under natural conditions. In the first place it would never have as smooth a surface as paper to crawl over, and again it is not at all likely that such a rate of speed would be maintained constantly. On the same basis of calculation the red and purple scales would each travel a maximum distance during their active period of 444 feet. These scales almost invariably settle within one or two days after emerging, but in the absence of food they might continue to be active for 4 days. The purple and red scales travel at about the same rate for both the minimum and maximum tempera-

tures, as may be seen from the table. It was thought that the purple scale young being much larger than the red would travel faster. The young purple scale has very short legs in relation to the size of the body, these scarcely showing beyond the margins and this probably accounts for its slow and rather awkward movements. The black scale, on the other hand, is a much better traveler but, contrary to what was expected, the partly grown scale when it loosened its hold after becoming fixed, could not cover the distance traveled by those just emerged from beneath the parent.

In these experiments little difficulty was met with in keeping the insects within the limits of a sheet of paper. They would almost invariably travel toward the light, so that when one margin of the sheet was reached it was turned around so that the opposite margin was nearest the light and the scales would soon turn about and go in the opposite direction. From these observations and experiments where the light was regulated it is concluded that these young scale insects are positively phototropic.

Travel Over Sand and Orchard Soil

In the experiments on the rate of travel over sand and ordinary orchard soil, the material was placed in saucers, plates and large sheets of black paper. A narrow strip of tree tangle-foot was placed around the plate or paper a little beyond the soil to capture the insects as they crossed over. Galvanized iron cylinders were also sunk in the soil in the field and a strip of tanglefoot placed on this a few inches above the surface. These cylinders were about 10 inches high and varied in diameter from 1 to 4 feet. These were later discarded for large sheets on which the soil was placed, or circles of paper with the inside margins covered, thus leaving a strip around the outer margins of the soil area where the scales could be more closely examined upon making their way from the center. In the following experiments the details were largely carried out by E. W. Rust.

Black Scale.—Temperature 85° F. About 50 active young just taken from under the adult were liberated in a plot of sand 6 inches in diameter. After one-half hour 5 had reached the outer margin and in three-fourths of an hour about half of the insects had reached the paper. Distance 3 inches.

Temperature 84°. Several hundred active young were placed in the center of sand in a dish at 3.30 p. m. At 3.55 one reached the edge of the dish; at 4 another; at 4.02 two more; while five more reached the edge by 4.20 and ten more by 4.30. By 5 dozens had reached

the edge of the plate. Distance traveled 4 inches. A similar experiment with ordinary orchard soil gave similar results.

Temperature 84°. A plot of orchard soil one foot square was enclosed with paper and several hundred active young liberated. When the experiment was begun the morning was foggy. In 55 minutes three reached the paper, a distance of 6 inches. By this time the sun was shining and the temperature had arisen to 96°. At a temperature of 102° all the scales died.

Temperature 85°. Four hundred or five hundred young were liberated in the center of an area of soil 2 feet square at 10.15 a. m. By 12.30 p. m. about 20 reached the margin; by 1 p. m. nearly 50, and at 5 p. m. about 100. Distance traveled 1 foot. Similar experiments showed that with a 2-foot strip of soil to cross, the first insects reached the margin in approximately 2 hours. Where the width of soil was 4 feet, out of several hundred liberated only a very few succeeded in crossing it during the same day.

Experiments relating to the effect of high temperatures on young black scales showed that it is an important factor in the causes of death. Several hundred young black scales were liberated on white cardboard in the sun with a temperature of 94° to 100°; at the end of two hours they were unharmed by the heat. A similar experiment is recorded with a temperature of 106° to 110°. At 106 the scales were lively, but as the temperatures increased they moved more slowly, and at 110 almost all movement ceased, although a 2 hours' exposure did not kill them.

Several hundred just emerged black scales liberated on soil with a temperature of 108° to 110° were active for about 1 hour, but at the end of that period some were dead and at the end of 1½ hours nearly all had been killed. A check lot in the shade were not affected. A large number of young placed upon a board with a temperature of 118°, all died in 5 minutes. Scales exposed in sun on soil where temperature was 119° to 122° died within 15 minutes. Under similar conditions with temperature of 130° death resulted in 5 minutes. A check lot in the shade were not affected.

Red Scale.—Fifteen active young picked from orange were liberated in sand with a radius of 1 inch. Two had radii of 2½ inches, and 2 more measured 3 inches in radius. None crossed the soil, even in the narrowest strip of sand. One particular insect was watched closely for ½ hour and in that time traveled but a small fraction of an inch. Another experiment showed that 1 scale out of 20 liberated crossed a 2½-inch strip in 18 hours. This was repeated the following day when none crossed over the soil. Twenty were liberated in the center of a 2-inch radius of soil and none reached the edge in 3 hours.

This was repeated twice and even on the following day none succeeded in crossing the soil.

Purple Scale.—At 9 a. m., September 17, with a temperature of 86°, 25 young purple scales were placed unharmed in the center of an area of sand having a 5-inch radius. None of these reached the edge during the same day nor the day following. A similar experiment resulted negatively. A third similar to the others was started at 9.45 and out of 25 liberated one reached the margin at 3.30 (5 3-4 hours). This is the only one that succeeded in crossing a 5-inch strip of sand. The following records were made on a 3-inch radius of sand:

9–20–10 T. 93° 20 liberated at 1.30 p. m. No results.
9–21–10 T. 82° 20 liberated at 9.45 a. m., 2 out at 12.30 p. m.
9–22–10 T. 65° 10 liberated at 9.30 a. m., 2 out at 1 p. m.
No more emerged by 5 p. m. or during next forenoon.

The experiments recorded here represent but a few of the total number made, but they will serve to show how they average. In the case of the black scale it was shown that about 4 feet of ordinary orchard soil is about the limit that will be traversed by the active young. Under favorable conditions they might, therefore, through their own powers of locomotion make their way from one citrus tree to another or to a second or third tree away. But the number thus traveling would be exceedingly small as compared with the total. These records were made on soil with an ordinary mulch. Tests were made on their powers of traveling over compact soil and they invariably showed very much greater progress. A compacted irrigation furrow enabled even the young red scale to travel two or three feet, while in a loose mulch this scale makes practically no progress. The young red scale in attempting to ascend a small particle of earth falls back again and this is repeated time after time. The same is almost as true for the young purple scale. Where there is a fine mulch, therefore, the chances of the young red or purple scale reaching an adjoining tree is practically negligible.

THE LIFE-HISTORY OF THE WALKING-STICK, DIAPHEROMERA FEMORATA SAY

By HENRY H. P. SEVERIN, Ph. D., *Professor of Zoölogy and Entomology, College of Hawaii*, and HARRY C. SEVERIN, M. A., *Professor of Entomology, South Dakota State College of Agriculture and Mechanic Arts*

(With Figs. 7–9, in Text.)

A number of naturalists have worked on the life-history of *Diapheromera femorata*, without as yet having accurately determined the number of molts that this insect undergoes. Riley (63, 73, 74 and 76) claims in several papers that this species "molts but twice," and this mistake has been carried into a number of text-books on entomology as well as into some bulletins and reports of the State Experiment Stations. Thomson (97) had some eggs of *Diapheromera femorata* sent to him from Toronto, Canada, and reared the walking-sticks which hatched from these in the Zoölogical Society's Garden at London. He claims that his specimens molted but four times. During the last four years we reared one hundred *Diapheromera femorata* under conditions which we made as normal as possible and found that twenty-three per cent. molted four times, seventy-six per cent. five times, and only one per cent. six times.

Bordage (8), in working with the walking-sticks, *Monandroptera inuncans* and *Raphiderus scabrosus*, found that there were five or six molts in both of these species. De Sinéty (90) found that the Asiatic species, *Menexenus obtusespinosus*, molted either four or five times and *Dixippus morosus* five or six times. Meissner (55), however, in a recent paper on *Dixippus morosus* claims that "sämtliche 42 von mir bis zum Imaginalstadium gezogenen Tiere haben sechs Häutungen durchgemacht; ich halte es auch für unwahrscheinlich, dass weniger vorkommen sollten." Evidently, this author was not acquainted with de Sinéty's (90) work on this same species. La Baume (4), in a recent paper on *Dixippus morosus*, writes as follows concerning the number of molts of this insect: "Die Anzahl der Häutungen gibt de Sinéty auf 4 bis 6 an . . ." Evidently La Baume has erred, for de Sinéty writes, "Dans les espèces asiatiques, nous en avons constaté tantôt un nombre fixe, . . . peut-être faute d'un nombre suffisant d'experiences 7 chez *Clitumnus patellifer* tantôt un nombre variable; 5 et 4 (*Menexenus obtusespinosus*), 6 et 5 (*Dixippus morosus*)."

The question naturally arises, what is the probable explanation of this discrepancy concerning the number of molts of *Diapheromera femorata?* Diapheromera, after casting its exoskeleton, eats a large

part of or even the entire exuvium, and it may be possible that Riley overlooked some of the molts on this account. If Thomson did not fall into this same error, it is difficult to explain why all of his walking-sticks should have molted four times. He writes, "the first specimen emerged on the 11th of June, and others from time to time during the summer. They changed their 'skins' four times before reaching maturity." In Wisconsin, the walking-sticks hatch in June also, but we noticed, as Riley (63, 73 and 74) also describes, that "some of them, however, continue hatching much later, so that all through the summer and even into fall, young individuals may be found."[1] In their natural habitat in Wisconsin, the walking-sticks feed most abundantly upon the leaves of the hazel-nut shrubs (*Corylus americana* Walt.) and to some extent upon the leaves of the linden (*Tilia americana* L.).

The following table shows the number of male and female walking-sticks which molted four, five or six times. All of these specimens were reared from fertilized eggs under normal conditions.

TABLE I

NUMBER OF MALE AND FEMALE DIAPHEROMERA FEMORATA WHICH MOLTED FOUR, FIVE OR SIX TIMES.

	♂	♀
Number of walking-sticks which molted four times	18	5
Number of walking-sticks which molted five times	34	42
Number of walking-sticks which molted six times		1
	52	48

It is evident from this table, that in those specimens which molted four times, the males greatly outnumbered the females.

The interval or periods between the molts (stages or stadia) and the total duration of these periods (or the post-embryonic development) in Diapheromera reared under normal conditions during June July and August, which time corresponds to the normal period of development of this Phasmid in its natural habitat in Wisconsin, is shown in the following table. In this table the specimens are arranged

[1] The development of *Diapheromera femorata*, however, is often retarded by parasitism, which fact may account for some of the immature walking-sticks being found late in autumn in Wisconsin. We have reared a leaf-ovipositing Tachinid, which Townsend (98) has recently described as *Phasmophaga antennalis* for us. This year (1910), a large number of walking-sticks parasitized by a host-ovipositing Tachinid were found. We succeeded in obtaining the egg, larval and pupal stages of this parasite but at the present writing the imago has not yet been bred.

in groups, the grouping being made according to sex and the number of molts.

TABLE II

STAGES IN MOLTING IN DAYS OF DIAPHEROMERA FEMORATA REARED IN JUNE, JULY AND AUGUST.

Date of hatching	Sex	Number of molts	Stadium I	Stadium II	Stadium III	Stadium IV	Stadium V	Stadium VI	Post-embryonic development	Date of last molt
1909 6/9	♂	4	14	7	10	9	.....	.....	40	7/19
1909 6/9	"	"	15	7	10	10	.....	.....	42	7/21
1909 6/11	"	"	13	7	9	9	.....	.....	38	7/19
1909 6/12	"	"	11	8	10	11	.....	.....	40	7/22
1909 7/22	"	"	10	9	11	13	.....	.....	43	9/3
Averages			12.6	7.6	10	10.4			40.6	
1909 6/9	♀	4	15	7	9	7	.....	.....	38	7/17
1909 6/9	"	"	15	9	11	9	.....	.....	44	7/23
1909 6/12	"	"	13	9	10	8	.....	.....	40	7/22
1909 6/12	"	"	13	13	8	10	.....	.....	44	7/26
1909 6/13	"	"	13	9	10	9	.....	.....	41	7/24
Averages			13.8	9.4	9.6	8.6			41.4	
1907 6/13	♂	5	8	7	9	9	10	.....	43	7/26
1907 6/22	"	"	10	9	9	9	8	.....	45	8/6
1908 7/6	"	"	9	9	7	9	11	.....	45	8/20
1908 7/9	"	"	12	8	9	11	13	.....	53	8/31
1908 7/13	"	"	10	7	7	11	13	.....	48	8/30
Averages			9.8	8	8.2	9.8	11		46.8	
1908 6/23	♀	5	13	8	9	7	9	.....	46	8/8
1908 6/24	"	"	13	10	9	8	13	.....	53	8/16
1908 6/30	"	"	12	9	9	9	12	.....	51	8/20
1908 7/17	"	"	10	6	8	10	13	.....	47	8/31
1908 7/22	"	"	10	9	9	12	10	.....	50	9/10
Averages			11.6	8.4	8.8	9.2	11.4		49.4	
907 6/13	♀	6	8	7	9	8	9	12	53	8/5

From this table, it is evident that there is a wide variability in the interval between the different molts in the same walking-stick and also a considerable amount of variation in the time of corresponding periods in different specimens. The period between molts varies, under normal conditions, from six to fifteen days, the first and last stadia being usually somewhat more prolonged than the intermediary ones. And yet Trouvelot (99) writes, that in the case of *Diapheromera femorata* "he had observed many specimens and the interval of molting was always seventeen days." What wonderfully regulated specimens he must have observed!

The following table shows the average measurements of various parts of the body of ten walking-sticks after the first and second molts and of five or ten male and female specimens after the third, fourth and fifth molts:

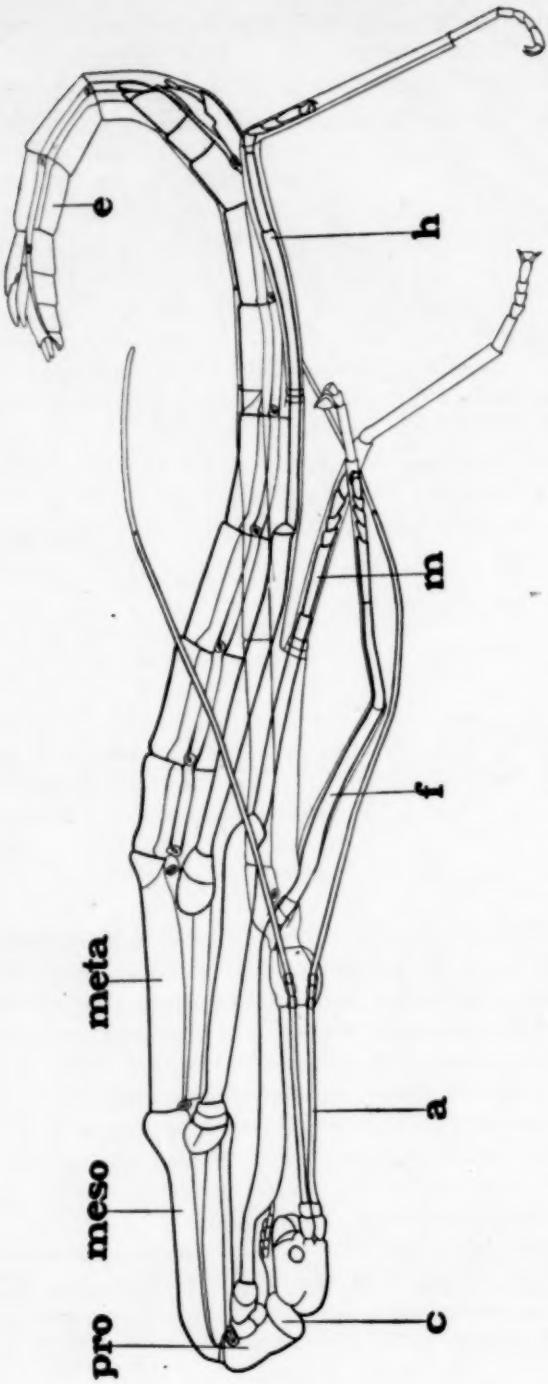

Fig. 7. Female *Diapheromera femorata* in the process of molting: *pro*, prothorax; *meso*, mesothorax; *meta*, metathorax; *c*, cervical ampulla which is a soft membrane joining the head dorsally to the prothorax; *e*, exuvium; *f*, front leg; *m*, middle leg; *h*, hind leg; *a*, antenna.

TABLE III

AVERAGE MEASUREMENTS IN MM. OF DIAPHEROMERA FEMORATA AFTER EACH MOLT.

	I Instar	II Instar	III Instar ♂	III Instar ♀	IV Instar ♂	IV Instar ♀	V Instar ♂	V Instar ♀	VI Instar ♂ mature	VI Instar ♀ mature
Length, distal end of front legs to end of abdomen	18.5	31.	46.5	46.	66.5	68.5	96.5	91.5	126.5	121.5
Length, head and body	10.7	19.8	30.5	30.7	43.5	45.	56.5	61.5	75.	80.
Length, head	1.1	1.3	2.	2.	2.5	2.5	2.5	3.	3.	4.
Length, pronotum	.6	1.	1.5	1.5	2.	2.	2.	2.5	3.	3.
Length, mesonotum	2.5	4.	6.2	6.2	9.	9.5	12.	12.5	16.	16.5
Length, metanotum (with median segments)	2.	3.5	5.5	5.5	8.	8.	11.	11.	15.	14.
Length, abdomen	4.5	10.	15.3	15.5	22.	23.	29.	32.5	38.	42.5
Length, front femora	3.	5.	7.	7.	10.	10.	15.5	13.	21.5	17.
Length, middle femora	2.	3.5	5.	4.8	7.	7.	10.	9.	14.5	12.
Length, hind femora	2.5	4.	6.	5.8	9.	9.	14.	11.	17.	15.
Length, antennæ	8.5	11.5	16.5	16.3	24.	24.	46.5	37.	56.	46.

A comparison of the average measurements of the male and female walking-sticks, which completed five molts, shows that the males excel the females in the lengths of the antennæ, all of the femora and in the distance from the distal end of the extended front legs to the end of the abdomen; the females, however, excel the males in the length of the abdomen.

There are certain indications which appear when the walking-stick is about to molt. The body becomes greatly distended, the lateral folds of the abdomen as well as the membranous connections between any two adjacent segments becoming greatly stretched; the body, in short, shows a rounding out, a certain fullness and plumpness. Previous to ecdysis, the Phasmid also stops eating and empties out most of the material from the digestive canal; but if, after molting, the chitinous lining of the fore-intestine and hind-intestine of the exuvium is examined, it is evident that not all of the contents have been evacuated. When hatched from the egg, the young creature is of a uniform pale green color, which a day or two before the first or second ecdysis deepens into a darker green; after either of these molts, the young walking-stick again assumes the uniform pale green color.

La Baume (4), in discussing the coloration in Diapheromera claims

that, "Die Jungen sind nämlich vom erwachsenen Tier gänzlich verschieden: sie sind vollkommen grün gefärbt. . . . Erst kurz vor der letzen Häutung geht diese Färbung allmählich in Braun über." Although we are dealing with the same species, our observations not only upon specimens reared in captivity, but also upon hundreds of individuals collected in their natural habitat are very different from those of this investigator. Many walking-sticks change their color from green to various shades of brown during the interval between the second and third molts, but more often after the third ecdysis Many female walking-sticks retain the green color throughout their natural life; in others, however, a marked individual variation in the color patterns exists after the last ecdysis, such as various shades of grey, brown or brick red often combined with various mottlings. Males which pass through four, five or six molts to complete their post-embryonic development, always have the characteristic adult color pattern after the last ecdysis; a day or two before the last molt, the newly developing color pattern becomes very prominent, especially in those specimens which have retained the green color up to this time.

In molting, the Phasmid bends down the prothorax at its union with the mesothorax so that the head lies beneath the latter (Fig. 7, *pro*). The top of the head may be in contact with a leaf, stem or other object, while the front legs and antennæ are thrown back along the sides of the body.

In the Phasmidæ, Mantidæ, Blattidæ and Acridiidæ, the cervical ampulla plays an important rôle in the process of molting. It consists of a soft membrane joining the head dorsally to the prothorax (Fig. 7, *c*) and can be transformed by the afflux of blood into a greatly swollen pouch, which projects out immediately behind the head. The turgidity necessary to break the old chitinous integument in the Acridiidæ is produced as follows according to Kunckel d' Herculais (50): *"ils remplissent leur jabot d'air au point de le distendre complétement;* des contractions musculaires, même peu énergiques, peuvent alors aisément chasser le sang dan l'ampoule cervicale. On comprend, d'après cela, que l'effort exercé par l'ampoule est d'autant plus energique que le jabot est plus gorgé d'air."

The old chitinous exoskeleton splits longitudinally at the region of the cervical ampulla and this split increases in length during the process of extrication. After the insect has completely withdrawn itself from the exuvium, the cleft extends along the dorsal median line from the head region to the posterior end of the thorax.

During the process of ecdysis, the dorsal surface of the prothorax pushes out first from the old integument; next comes the head, fol-

lowed then by the rest of the thorax, and finally by the abdomen (Fig. 7). Of the appendages, the middle legs are liberated first, then the antennæ, followed by the front and finally by the hind legs. One can easily observe the body and legs gradually withdrawing as the old skin becomes empty (Fig. 7, *e*).

A molting specimen examined under a binocular microscope, shows that a peristaltic-like movement passes from the posterior end of the abdomen forward at intervals. With each series of these movements the body is withdrawn a short distance out of the old skin, the legs assisting in this process of extraction from the old integument. At each attempt to withdraw the legs from the old exoskeleton, such an energetic pull is exerted upon the limbs, that each coxa presses against the body and forms there a temporary indentation.

After the walking-stick has withdrawn its appendages, it appears to be exhausted by the tedious task of ecdysis. It frequently happens that the entire body is not completely withdrawn from the cast skin, and in such instances the insect may remain suspended by the tip of the abdomen within the exuviated integument for half an hour or longer. In this position the head hangs downward, the legs are sprawled out and the antennæ are held forward parallel to the long axis of the body. This attitude does not have any resemblance to the characteristic resting posture which the walking-stick assumes during the day-time; but in all probability it allows the newly exposed integument to harden and prevents any malformations from developing.

The body of the walking-stick, as well as the legs and antennæ, may assume all sorts of abnormal shapes when the insect is unable to extricate itself entirely from the exoskeleton. If, in the process of molting, a specimen falls from the leaf or branch to which it was clinging to the bottom of the breeding cage, many malformations may result, especially if the insect experiences difficulty in withdrawing from the old skin. If any leg should happen to be caught in the exuvium, that leg is usually thrown off. We have observed one male individual throw off all of its legs during the last molt and even then it was unable to free itself entirely (Fig. 8). After the newly exposed integument of this specimen hardened, the body assumed an S shape (Fig. 8). It may be possible, that whenever difficulty of this nature occurs during the process of molting that the exuvial or molting fluid which lubricates the two skins at the time of ecdysis, hardens and prevents the parts from being extricated. In all probability autotomy among the Phasmidæ owes its origin to the difficulty experienced in withdrawing the appendages during the process of ecdysis.

An exuvium immediately after being shed, may be stretched out

without tearing, but after a short time the old integument hardens and it cannot then be extended to its full length.

Fig. 8. Male *Diapheromera femorata*, which threw off all of its legs during the last molt.

After molting, the walking-stick usually eats its cast-off skin. The following observations of a specimen eating its former exoskeleton are copied in detail from our notebook:

The insect was suspended by the posterior end of the abdomen in the molted skin for forty minutes. The tibiæ were then flexed at the knee producing a twitching movement. Suddenly the Phasmid bent its body upward, the legs caught hold of the petiole of the leaf, and the terminal end of the abdomen was pulled out of the exuvium. It began to feed on the head of the molted skin at once and bit off both antennæ and one of the front legs, the latter adhering to the leaf by the tarsus. The basal ends of both antennæ were consumed at the same time, the antennæ swaying around in all directions with each bite. Next, the front leg which adhered to the leaf was bitten in two through the femur, after which this free portion of the leg was devoured, femur first. The walking-stick now bit off the other front leg at the coxa and left it hanging on the leaf by the tarsus. Next it started to eat the mesothorax of the discarded integument. When the walking-stick came to the middle legs, it took the bent knee of one of these legs into its mouth and consumed the femur and tibia at the same time. The creature then bit off the other middle leg at the coxa and ate it. It now began to eat at the posterior end of the abdomen and met with one of the hind legs lying along the side of the abdomen. The tarsus of this leg was bent at the joint with the tibia and this bent portion entered the mouth first, the tarsus and part of the tibia being consumed at the same time. It ate the rest of the tibia and left the femur untouched. Next the Phasmid tasted the metathorax, but soon it came back to the femur and ate this portion of the leg. Then the insect bit off the other hind leg at the coxa, but the leg dropped to the ground. Finally the walking-

stick devoured the remaining portion of the metathorax and abdomen. The appetite of the creature was still not satisfied, for it went carefully over the leaf, vibrating the palps continually in search of more of its integument. Finally the walking-stick discovered the front leg, which was still adhering to the leaf and devoured it. Again it began to search actively for more of its former exoskeleton. We then took another molted skin of a different walking-stick and offered it to the greedy creature, and the Phasmid began to devour this skin also. It ate, however, only the head and front leg, when it was disturbed at its meal by another walking-stick coming in contact with it. Apparently the instinct of the walking-stick does *not* carry it far enough to recognize its own molted skin.

Godelmann (33) in his work with *Bacillus rossii* writes, "Nach der letzten Häutung, die bei meinen Zuchten etwa in December erfolgte, beginnt das Thier sofort Eier zu legen." Meissner (55), however, found that with *Dixippus morosus*, "Etwa 8–10 Tage nach der VI Häutung beginnen die Imagines Eier abzulegen und setzen dies nun ständig fort." With *Diapheromere femorata*, we also found that the females do not begin egg-laying immediately after the last molt, but that there is an interval of 6 to 10 days between the last molt and the laying of the first egg. These intervals in three specimens, which had been reared under as nearly normal conditions as possible and which had molted four times, were 7, 9, and 10 days, or on an average 8.66 days; the intervals in twelve walking-sticks which had molted five times, were 6, 6, 7, 8, 8, 8, 8, 8, 9, 10, 10 and 10 days, or on an average 8.16 days. From the averages it is apparent that no very great difference exists in the interval between the last molt and the laying of the first egg in the walking-sticks which molt four or five times.

Specimens of Diapheromera, which molted four times, reached sexual maturity, on an average, in 50.06 days, while individuals which molted five times required 57.56 days on an average, or an extra 6.6 days before beginning the egg-laying period. It is evident thus, that those walking-sticks which molted four times, omit the fifth molt and yet reach sexual maturity nearly a week earlier than those specimens that pass through five molts. In all probability, temperature plays an important rôle in the rate of development, but temperature alone does not explain why some walking-sticks molt four times and others five times. We have repeatedly reared a number of Diapheromera which were hatched on the same day, fed with the same kind of food and kept in the same breeding cage throughout their entire life history under exactly the same conditions of temperature, and yet some specimens molted four times while others molted five times. Further experiments are necessary to determine a solution of this problem.

The eggs, after passing out of the vaginal orifice, may be retained

for a number of hours within the peculiar "external uterus" formed by the ovipositor (Fig. 9, *e*).

After being released by the ovipositor, the eggs are dropped, one at a time, to the ground from wherever the female may be. In this way the eggs are scattered upon the ground below the natural food plant and here they remain over winter. Riley (63, 73 and 74) gives an interesting account of the egg-laying in *Diapheromera femorata*, an insect which may, at times, become exceedingly abundant and very injurious. He writes, "The eggs are simply dropped loosely

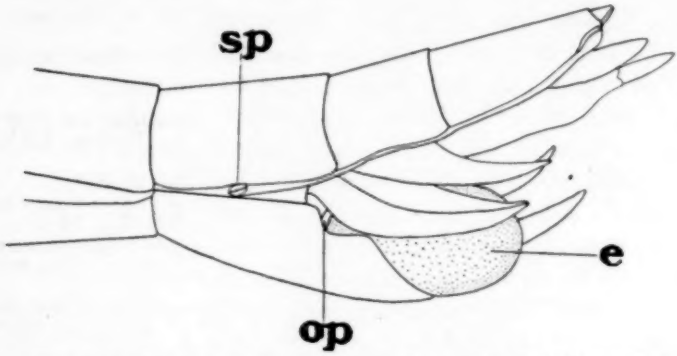

Fig. 9. The posterior end of the abdomen of a female *Diapheromera femorata*, showing an egg held within the "external uterus" formed by the ovipositor; *sp*, spiracle; *e*, egg; *op*, operculum.

upon the ground from whatever height the female may happen to be, and, during the latter part of the autumn where the insects are common, one hears a constant pattering, not unlike drops of rain, that results from the abundant dropping of these eggs which in places lay so thick among and under dead leaves that they may be scraped up in great quantities."

Concerning the egg-laying of *Bacillus gallicus*, Dominique (21 and 25) emphasizes the fact that "jamais nous n'avons en à enregistrer une seule ponte diurne." *Diapheromera femorata*, however, lays its eggs during both day and night.

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TWO RHOPALOSIPHUM SPECIES AND APHIS PULVERULENS, N. SP.

By C. P. Gillette.

Rhopalosiphum pastinacæ (L.) and *R. capreæ* (Fab.)

Apparently these two species have been confused by aphidologists. As I have material that seems to me to straighten out the tangle, I venture to give it.

The description of *pastinacæ* by Linnæus is satisfied about equally well by the louse I am considering as this species, and by the louse described by Fabricius, and later by Kaltenbach[1] as *capreæ*. At least, the species considered in this paper as *pastinacæ* answers the Linnean description and does not answer the excellent description of *capreæ* as given by Kaltenbach. More recent descriptions seem mostly to have been of *capreæ* and under several different names.

Rhopalosiphum capreæ Fab. Perhaps the fact that Koch[2] de-

[1] Monographie der Pflanzenlause, 1843, p. 109.
[2] Die Pflanzenlause Aphiden, 1857, p. 41.

scribed and figured this species as *pastinacæ* has had much to do to cause the confusion of later writers. Koch's *capreæ* seems to be neither this species nor *pastinacæ*. Buckton[3] recognized the prominent distinctive characters of the two species, as did Passerine. Mr. J. T. Monell[4] obtained his *salicis* from willow and described the winged form without noticing the small supra-caudal tubercle. In a recent letter Mr. Monell has told me that he now considers his *salicis* synonymous with *capreæ* Kalt. Doctor Weed[5] later found the sexuales of this species on willow in Ohio and described them as *Siphocorinæ salicis* Monell. Mr. J. J. Davis has called my attention to the fact that Doctor Oestlund[6] seems to have described this louse as *archangelicæ* which seems to me to be the case. I have not come upon any description of *pastinacæ* since Buckton's, already mentioned, except that of *xylostei* Schr., which is probably a synonym of this species. The striking character in *capreæ*, which in the material that I have studied is constant in all forms, larvæ, alate and apterous viviparæ, sexuales, and pupæ, is the supra-caudal tubercle or spine which, in the apterous form, is as long or longer than the cauda, but which is a tubercle only in the alate forms (See figures.).

All the specimens of these two forms that I have seen, separate readily into two very distinct species without intergrading, and without a mingling of the two forms in the same lot as follows:

Joints 4, 5, 6, and antennal spur sub-equal, the spur usually distinctly the longest, cornicles fully ¾ as long as 3d joint of the antenna, a small tubercle on the alate form and a large one on the apterous individuals always present..... *capreæ*.

Joint 6 of the antenna distinctly shorter than 5, the 4th still shorter and its spur nearly as long as joints 4, 5 and 6 combined, cornicles seldom much exceeding ½ the 3d joint of the antenna in length, and supra-caudal tubercle or spine entirely absent ..... *pastinacæ*.

Kaltenbach called attention to the interesting habits of *capreæ* in that it lived upon two very different groups of plants, the willows (*Salix* species) and several species of the Umbelliferæ. Later writers have added to the number of food plants but, so far as I have learned, they have all been willows or members of the parsley family.

The food plants given for *capreæ* by the writers mentioned, and by Fabricius and Schrank are as follows:

Fabricius.—*Salix capreæ.*

Schrank.—Willow.

Kaltenbach.—*Salix amygdalina, babylonica, capreæ*, and *alba, Heracleum siphondylium, Angelica sylvestris, Aegopodium podograria, Choerophyllum temulum, Pastinacea sativa* and *Conium maculatum.*

[3] Monograph of British Aphids, II, pp. 25, 27.
[4] Bull. 5, U. S. Geol. Survey, 1879, p. 26.
[5] Trans. Amer. Ent. Soc., 20, 1893, p. 297.
[6] Aphididæ of Minn., 1887, p. 70.

Koch.—*Salix caprea.*
Buckton.—*Salix* species.
Monell.—*Salix lucida, nigra* and *babylonica.*
Oestlund.—*Angelica atropurpurea.*
Weed.—*Salix* species.

From Mr. Bragg's collections made at Fort Collins, Col., I extract the following records: From parsley, *Petroselinum hortense,* August 25, 1907, October 5, 1907, November 1 to 25, 1910, and from willow, June 22, 1908. Mr. Bragg also took this species at Amherst, Mass., July 26, 1909, on *Pastinaca sativa,* and at Webster, Mass., July 26, on the same plant and on caraway, *Carum carui.*

Prof. Ellsworth Bethel of Denver, Col., sent me a fine lot of specimens which he took at Tolland, Col., at an altitude of 8,000 feet on *Ligusticum porteri,* October 19, 1908.

I have also received specimens from Prof. Edith M. Patch taken at Orono, Me., on caraway, July 29, 1910, and Mr. J. J. Davis wrote me from Chicago that he had taken the same louse in great numbers from *Zizia aurea* in Illinois.

So all the way through this species seems to hold to species of *Salix* for the winter host plant and to species of *Umbelliferæ* for its mid-summer hosts as Kaltenbach pointed out when he wrote his description.

Rhopalosiphum pastinacæ (L.). Linnæus described this species from the common parsnip, *Pastinaca sativa.* The only subsequent description I have seen of this species under this name is the one by Buckton in his Monograph, volume II, p. 25. It seems to me very probable that *xylostei* Schr. is a synonym of this species. Shrank's description would not indicate a different species; Kaltenbach's description of it fits *pastinacæ* which he seems not to have known, and the description by Buckton hardly indicates that *xylostei* is a good species. Schrank took this species from honeysuckle (*Lonicera* sp.); Buckton records his specimens from *Lonicera xylostei* and *periclyneum*; Kaltenbach's were from *Lonicera periclyneum* and *Conium maculatum,* and Koch records his from *Lonicera xylostei.* A slide from Mr. Monell labeled *xylostei* is marked "*Lonicera pastinaca* St. Louis, November 4" and I have just recently received specimens of what seems to be the same louse from Miss Mary Murtfeldt, Kirkwood, Mo., which she reported to be injuriously abundant upon honeysuckle nearly every year.

These references to *xylostei* records are given to show how perfectly the food plants fit in with those of what I have been calling *pastinacæ,* and which seems to have for its hosts several species of the *Umbelli-*

ferœ during the summer months and the honeysuckles (*Lonicera* sp.) during fall, winter and spring.

Our specimens of *pastinacœ* have been taken by Mr. Bragg as follows: From *Heracleum lanatum* October 27 and 28, 1908, and November 1, 1908; in all cases alate viviparous females and a few winged males were taken but no oviparous females. From honeysuckles (*Lonicera* sp.) specimens were taken June 28, 1910, July 2, 1907, and September 28, 1910, all viviparous females; specimens taken October 9, 1910, October 11, 1910, November 7, November 10 and November 12, 1910, all had males and oviparous females.

The conclusions then are that these species of Rhopalosiphum have several species of the Umbelliferæ as summer host plants, that *capreæ* goes to the willows for the fall, winter and spring, that *pastinacœ* goes to the honeysuckles for the winter, that *xylostei* is probably a synonym of *pastinacœ* though I have no European material of this species to study, that Koch's *pastinaceæ*, Monell's *salicis*, and Oestlunds *archangelicæ* are all *capreæ*.

Descriptions of *Rhopalosiphum capreæ*. Plate 9, Figures 10–16.

Specimens from garden parsley, *Petroselinum hortense*, at Fort Collins, Colo., November 1, 1910.

Alate Viviparous Females.—Color of prothorax and entire abdomen green with slight pulverulence beneath. Head, antennæ, mesothorax above and below, metathorax, tarsi, and distal ends of tibiæ black; legs otherwise yellowish green as are the cornicles and cauda; anal plate dusky, cornicles and cauda in some examples a little dusky. The cornicles are .30 to .35 mm. in length, slender at base and enlarging at the middle to twice the basal diameter and somewhat constricted again near the tip, which ends in a moderate flange; length of cauda, .10 mm.; above the cauda is a prominent tubercle from ⅓ to ½ the length of the cauda (see Fig. 11). Length of body 1.50 to 2 mm.; length of antenna 1 to 1.10 mm.; length of wing 2.60 mm. Joints of antenna about as follows: III, .32–.37; IV, .13–.15; V, .12–.13; VI, .12–.13; spur, .15–.17 mm.; joint III tuberculate with numerous sensoria.

Apterous Viviparous Female.—General color pale greenish to very pale yellowish with no dark parts but the eyes and tarsi. The striking peculiarity of this form is the tubercle upon the 8th segment which is as long as the cauda and blunt at the apex (see Fig. 12). Length of body 1.70 to 2 mm.; cornicle .40 mm. long, the club being less abrupt than in the alate form. Antenna .80 mm. long; joints III, .20; IV, 10; V, .10; VI, .10; spur, .13 mm. There are distinct antennal tubercles and the body is remarkably smooth and free from hairs and on the dorsum the surface is minutely punctate.

The larvæ and pupæ also show the tubercle well developed.

Alate Male.—I have seen but one male. It was taken from parsley November 1, 1910, and differs from the alate viviparous female by being smaller, and by having a larger number of sensoria on joint 3, about 7 on joint 4, about 7 on joint 5, and 4 on the sides of joint 6.

Aphis pulverulens, n. sp. Plate 9, Figures 1 to 9.

Specimens taken from *Symphoricarpos occidentalis* at Fort Collins, May 31, 1909; L. C. Bragg, collector.

Apterous Viviparous Female.—The body is covered with a white silvery secretion, giving it the appearance of a species of *Pemphigus*. When the secretion is removed, the body is of a sordid greenish brown color. The greater portion of the antennæ, the tarsi, distal ends of tibiæ, distal portion of beak and eyes are black, or blackish. The eyes are really a very dark red; the head and prothorax are a little dusky, as are the basal joints of the antennæ; the head and prothorax are very narrow; the antennæ are on somewhat prominent tubercles, which, however, have no length on the lateral margins next to the compound eyes; joint 6 of antenna tapering gradually into spur; cornicles short and weak and somewhat curved and light in color, very smooth and with little or no flange, diameter slightly greater near the base than near the distal end; cauda broadly rounded, and not more than half as long as it is wide on the basal margin; beak barely attaining third coxæ; body very smooth and free from hairs.

Body varying little from 3 mm. long by 1.07 mm. wide. Length of cornicles .21 mm.; hind tibiæ 1.63 mm.; joints of antennæ: III, .90; IV, .49; V, .37; VI, .14; spur, .57 mm.

The larvæ are pale carneous and may be tinged with green.

It seems likely that these apterous females are stem-mothers.

Alate Viviparous Females. Reared from the same lot as the apterous form described above.

The entire body and legs are covered with a cottony secretion as in the apterous form. General color of body, legs and antenna the same as in the apterous. Lobes of the thorax above black, head and prothorax black or blackish, cornicles as in the apterous form except that they are dusky brown in color. Antennæ with numerous hairs, and tuberculate sensoria; cauda small, rounded at apex, broader than long; cornicles weak and without flange; stigma of wing long, narrow and parallel sided, second fork of cubitus a little nearer the apex of the wing than to the first fork.

Length of body 3 mm., width 1.34 mm.; antennæ 2.78 mm.; joints of antennæ about as follows: III, .90; IV, .57; V, .43; VI, .13; spur, .59 mm.; cornicle, .20 mm.; wing, 4 mm.

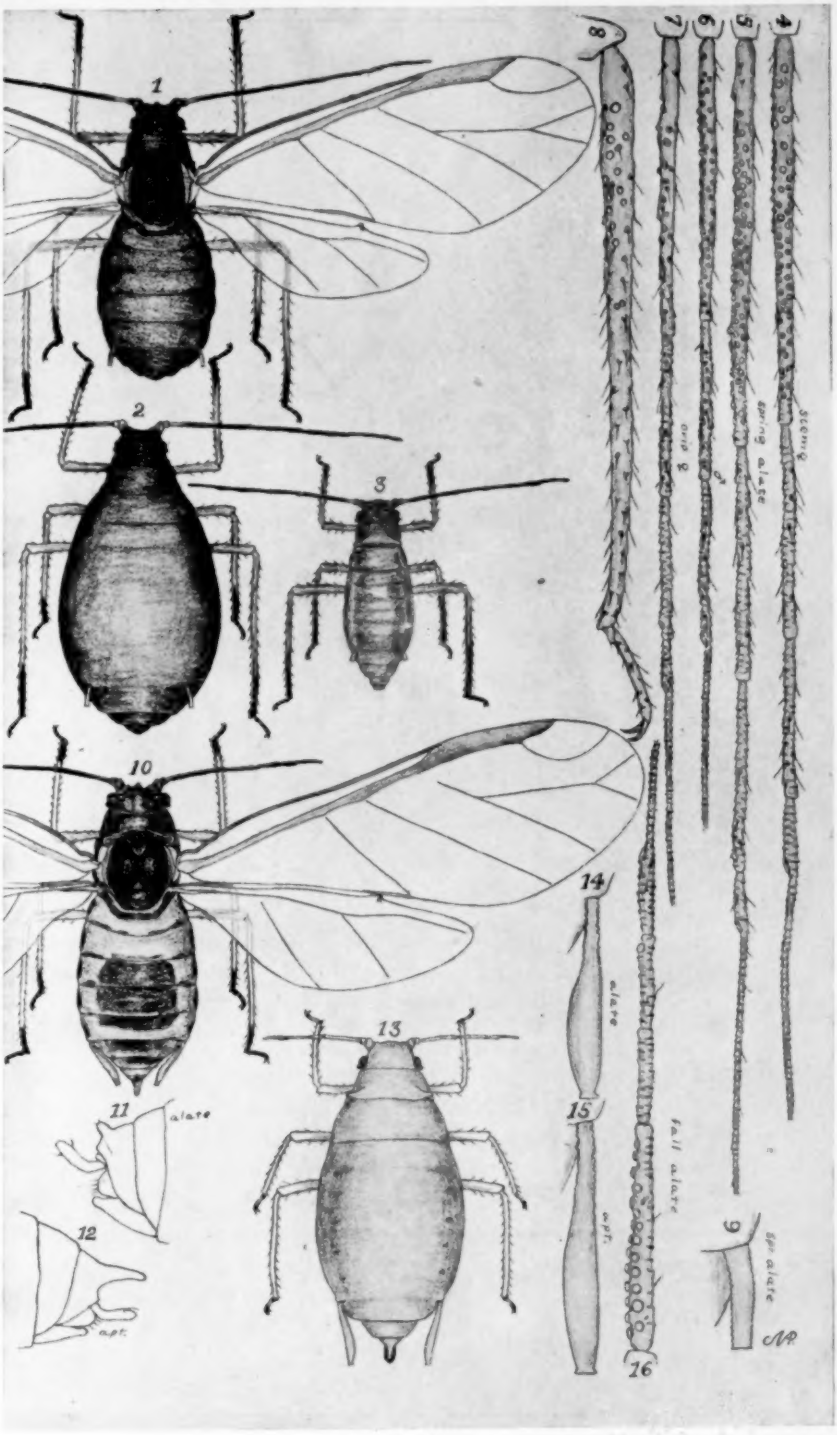
Male: Apterous, from stems at ground and on upper roots of *Symphoricarpos occidentalis*, taken at Fort Collins, October 15, 1910.

General color carneous, or yellowish brown; head, entire antennæ, cornicles, tarsi, and distal ends of tibiæ and femora black or blackish; eyes dark red.

Length 1.90 mm.; antenna 1.84 mm.; joints of antennæ: III, .60; IV, .36; V, .26; VI, .10; spur, .40 mm.

Antenna with a moderate number of short hairs; joint 6 tapers gradually into the spur; sensoria abundant on joint 3 and a few on joint 4.

Oviparous Female: Apterous and a little darker than the viviparous female, also smaller and more elongate. Cornicles concolorous with the body; entire body more or less heavily powdered above and below; length of body 3 mm.; cornicles weak, cylindrical, .24 mm. long, without flange; length of antenna 2.20 mm.; joints about as follows: III, .70; IV, .35; V, .31; VI, .14; spur, .44 mm. Tarsi, distal ends of tibiæ and most of distal portion of the antennæ black or blackish; hind tibiæ with numerous circular sensoria (or scent glands) on upper third of hind tibiæ.



Aphid Structures

Eggs pale yellowish, covered somewhat with the waxy secretion but only accidentally; deposited on the lower stems just beneath the surface of the ground.

We have been taking this louse for the past three seasons about Fort Collins and always on *Symphoricarpos* at or below the surface of the ground throughout the year. It seems to be a bark feeder exclusively. While this louse may not properly belong in the genus *Aphis*, it fits here as well as in any genus known to me.

Plate 9, Figs. 1 to 9, *Aphis pulverulens*; Figs. 10 to 16 *Rhopalosiphum capreæ*. 1, Alate; 2, apterous viviparous females; 3, male; 4, antenna of Fig. 2; 5, antenna of Fig. 1; 6, antenna of male; 7, antenna of oviparous female; 8, hind tibia of oviparous female; 9, cornicle of alate female; 10, alate viviparous female; 11, end of abdomen showing tubercle of the preceding; 12, the large tubercle or spine of the apterous female; 13, apterous female; 14 and 15, cornicles of alate and apterous females; 16, antenna of alate female.

Figs. 1, 2 and 3 are enlarged 14 diameters; 4 to 9 enlarged 60 diameters; 10 and 13, 20 diameters; 11 and 12, 40 diameters; 14, 15 and 16, 80 diameters. Original, Miss M. A. Palmer, Delineator.

LIST OF THE APHIDIDAE OF ILLINOIS, WITH NOTES ON SOME OF THE SPECIES.

(*Concluded from p. 496, Vol. 3.*)

By John J. Davis, *Office of the State Entomologist, Urbana, Illinois.*

†*Phorodon scrophulariæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 72. I have never seen this species, and it has only been recorded once since the original description, W. T. Clarke having reported collecting it in California on *Scrophularia* sp.[1] First reported by Thomas.

**Phorodon galeopsidis* Kalt.: What I consider this species and have described below was found quite common on *Polygonum pennsylvanicum* at Oak Park and Urbana from July to October. It doubtless occurs at other seasons on the same plant, but it has never been looked for other than in the months mentioned. It has not heretofore been recorded from America, although I surmise that the species referred to as *Siphonophora polygoni* by Thomas and Oestlund are this species. It colonizes on the under surface of the leaves, principally along the larger leaf veins. The oviparous female was not taken.

Winged viviparous female.—Head dusky (Pl. 10, fig. 3), thoracic plate dark olive, abdomen yellowish to yellowish green with a dark dusky green rectangular spot on the dorsum, which sometimes is only present on the two segments anterior to the cornicles, and a row of very faint dusky spots on each side of the abdomen.

[1] A list of California Aphididæ. Can. Ent. Vol. XXXV (1903), p. 252.

Antenna dusky to blackish, the two basal segments also dusky, but paler than the others; VI filament longest, it being about twice the length of the next longest segment (segment III), IV fully a third shorter than III, IV and V subequal, VI base about 2-5 the length of V or 1-8 the length of VI filament, total lengths about 1 1-2 times that of the body; III with 23–33 (usually 27 or 28) small but conspicuous, circular, irregularly placed sensoria, IV with 13–18, V with 1–4, usually in a row and the usual larger one at distal end, VI base with a large one surrounded by a number of minute ones at distal end. (Pl. 10, fig. 2.) Eyes red. Beak not reaching to coxæ of the second pair of legs. Wings with veins dark brown and distinct, third discoidal branching slightly nearer to the apex than to where the second branches. (Pl. 10, fig. 1.) Legs pale yellowish, excepting the joints, which are brownish, and the tarsi, which are black. Cornicles reaching beyond tip of abdomen, very slender, the basal two-thirds swollen, the distal third pale yellowish to greenish yellow and dusky at tips. (Pl. 10, fig. 4.) Style moderately long and slender, about a third the length of cornicles. (Pl. 10, fig. 5.)

Measurements.—Length of body, 1.8 mm.; width, 0.72 mm.; length of forewing, 3.0 mm.; width 1.25 mm.; antenna, I, 0.10; II, 0.065; III, 0.38–0.44, avg. 0.42; IV, 0.27–0.36, avg. 0.33; V, 0.245–0.31, avg. 0.28; VI, base, 0.09; VI, filament, 0.82–0.93, avg. 0.86; avg. total, 2.145 mm.; cornicles, avg. 0.42 mm.; style, avg. 0.145 mm.; hind tarsus, avg. 0.11 mm.

Wingless viviparous female.—Entire body pale yellow. Head and first antennal segment bearing several whitish capitate hairs. Antennæ whitish, about as long as body, relative lengths of segments as in winged viviparous female. Eyes dark red. Beak not reaching beyond coxæ of second pair of legs. Legs whitish. Cornicles and style whitish, otherwise as in winged.

Measurements:—Average, in mm. Length of body, 2.3; width, 1.07; antenna, I, 0.095; II, 0.06; III, 0.45; IV, 0.35; V, 0.29; VI, base, 0.085; VI, filament, 0.85; cornicles, 0.67; style, 0.19.

Winged male.—In relative measurements similar to the winged viviparous, differing from it as follows: head and thorax blackish, abdomen pale yellowish, with a slight faint orange tint, the longitudinal median dorsal red line which is so conspicuous in the pupal stage is faintly visible, and on each side of the median, extending longitudinally, are short dusky transverse markings, one or two of which are sometimes connected at the median line, thus forming single transverse bars on the respective abdominal segments. Entire body covered with a fine pulverulence. Antennæ black, and with circular sensoria irregularly placed as follows: III, 33–39; IV, 20–31; V, 8–13. Femur dusky to blackish, being paler at the base, tibia pale excepting black distal end, and tarsus black. Cornicles and style dusky and a black spot at the base of each cornicle.

The conspicuously marked immature male is at once distinguished from the pale yellowish young of the viviparous generations. It is characterized by a bright reddish longitudinal median dorsal line on a pale yellowish background, and extends the entire length of the body. In the adult pupa the line is not such a bright red, and the abdomen is more of a pale orange color.

**Macrosiphum asclepiadis* Cowen: Bull. Col. Agr. Expt. Station No. 31, Tech. Ser. No. 1, (1895), p. 123. A rather common species in Illinois, on *Asclepias* sp. This may have been one of the species

which Thomas seems to have confused in his description of *Siphonophora asclepiadis* Fitch.[1]

[d]*M. calendulæ* Monl.: Bull. Geol. and Geog. Surv. Vol. V, No. 1 (1879), p. 21. Mr. Monell (*loc. cit.*) determined specimens collected in Illinois as questionably this species. I am unacquainted with it.

M. cerealis Kalt.: Pergande, Bull. Div. Ent. U. S. Dept. Agr. No. 44 (1904), p. 18. I have been unable to separate this species from *granaria*, and although I believe the two synonymous, leave them distinct for the present. First reported by Pergande.

M. circumflexum Buck. (=? *Myzus vincæ* Gil.): Buckton, Monograph of British Aphides, Vol. I (1876), p. 130, col. figs.; Gillette, Can. Ent. Vol. XL (1908), p. 19, figs. What I consider this species is found in greenhouses in Illinois, and is often destructively abundant on dahlia, easter lily, *Vinca*, and maiden-hair fern (*Adiantum*). First reported by the writer.

**M. cratægi* Monl.: Bull. U. S. Geol. and Geog. Surv. Vol. V (1879), p. 20. I found this species common on the under surface of the leaves of *Cratægus* in the Chicago parks. It was not, however, sufficiently common to be injurious. I believe this species has not been reported since the original description by Monell. Prof. W. T. Clarke, in his "*List of California Aphididæ*"[2] lists *Aphis cratægi* Monl. from California. He doubtless had another species as Monell's *cratægi* is a true *Macrosiphum*. The antenna of the wingless viviparous female is shown in Pl. 10, fig. 6.

[t]*M. curcubitæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 67. Very common and sometimes destructive to squash vines. Usually, however, they do not become injuriously abundant until in the fall when the plants are fully matured, and fruit nearly ripe. First reported by Thomas.

M. cynosbati Oestl.: Davis, Annals, Ent. Soc. America, Vol. II (1909), p. 38, figs. Colonizes on tender terminal twigs and leaves of the common ornamental currant (*Ribes aureum*), often seriously stunting the growth. First reported by the writer.

[t]*M. erigeronensis* Thos.: Sanborn, Kans. Univ. Sci. Bull. Vol. III (1904), p. 76, figs. Common on *Erigeron canadense* throughout the state. First reported by Thomas.

[d]*M. fragariæ* Koch. var. *immaculata* Riley: Rural World, December 11, 1875. This variety was described by Doctor Riley in the Rural World, characterizing it as different from *fragariæ* Koch by the absence of black lateral abdominal spots in the winged female, and in

[1] 8th Rept. State Ent. Illinois, 1880, p. 58.
[2] Can. Ent. Vol. XXXV (1903), p. 250.

the head of the wingless being yellow.[1] Nothing has since been added to our knowledge of the species, though it has been mentioned in literature by several authors, excepting the notes made by Monell[2] from an examination of a single winged specimen in Riley's cabinet,

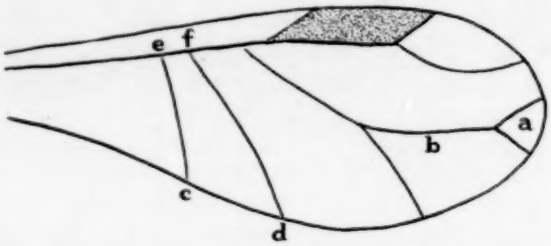


Fig. 10. Sketch of wing of *M. fragariæ* var. *immaculata* Riley [After Monell].

and by Mr. Theo. Pergande[3] who, after examining the few poorly preserved specimens (probably pinned) of Riley's *immaculata*, states that his *Macrosiphum trifolii* is distinct. Nor has it been identified since the original description, and it is probable that the species referred to by Riley as *immaculata* is some other—possibly *A. forbesi*. Mr. Monell has very kindly placed at my disposal the original notes which he made August 21, 1876, from a specimen in Riley's collection. They are as follows:

"62° Cell formed by secondary branches of cubital very small (a). The upper branch in *S. fragariæ* Koch (see pl. XXXII Pflanzenlause) being quite equal in length to part marked *b* in explanatory sketch. The first and second discoidal are almost parallel in Koch's figure [while in *immaculata*] space at apices [*c d*] is little over twice as wide as space at bases [*e f*]. Hind wings have apex more pointed than in Koch's figures. It has two discoidals, costal vein seems rather straight. Little (hooks) protuberances upon costal edge (Koch's figure does not show costal edge). Drawn from dried specimen in Mr. Riley's cabinet under small lens August 21, 1876."

The drawing referred to by Mr. Monell is only 13 mm. in length, and I have drawn free-hand (fig. 10) a reproduction which, for the purpose here intended, is sufficiently accurate. The venation agrees quite well with *Aphis forbesi* Weed,[4] but differs from that species in lacking the black lateral abdominal spots. Although these notes are insufficient to draw any reliable conclusion, they are given with the hope that they may later be a help in a solution of the problem. This species has never been positively reported from Illinois.

[1]*M. gerardiæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 66. This species has not been reported since the original description.

[1]Mr. J. T. Monell, in a letter dated December 7, 1910, writes: "There is no formal description, but simply what Thomas gives in his Illinois report. I may note that Riley did not at that date know a *Siphonophora* from an *Aphis*."

[2]Bull. U. S. Geol. and Geog. Surv., Vol. V (1879), p. 22.

[3]Bull. U. S. Depart. Agr., Div. Ent., No. 44 (1909), p. 22.

[4]The venation of *forbesi*, however, varies considerably.

M. granaria Buck.: Pergande, Bull. Div. Ent., U. S. Dept. Agr. No. 44 (1904), p. 14, figs. The most common and generally distributed grain louse in Illinois, but seldom injurious. First reported by Pergande.

M. lactucæ Schr.: Thomas, 8th Rep. State Ent. Ill. (1880), p. 60. What is doubtfully referred to this species is common on cultivated lettuce in greenhouses, where it often is a nuisance of considerable importance. We have also taken it on celery out-of-doors.

Winged viviparous female.—Head (Pl. 10, fig. 7) and thoracic shield jet black. Abdomen pale green with blackish markings as shown in figure (Pl. 10, fig. 8). These markings vary considerably in size, but the figure is typical. Eyes dark red to blackish. Antennæ black; more than a third longer than the body; segment VI filament longest, it being more than twice the length of III, IV and V subequal and each about two thirds the length of III, VI base about one fourth length of IV or one twelfth of the filament; segment III with 40 to 50 irregularly placed circular sensoria; segment IV with 7 to 11 in a row; V with the usual one at distal end, and VI base with the usual distal one surrounded by several smaller ones (Pl. 10, fig. 9). (In two examples, both from same individual, segment III had but 27 and 28 sensoria, and IV but 2 and 3, respectively.) Beak reaching coxæ of second pair of legs, the tip black. Wings with brownish venation (Pl. 10, fig. 10). Cornicles black, reaching to or slightly beyond tip of abdomen. Style dusky or brownish to blackish, about half the length of cornicles.

Pupa.—Entirely pale green. Eyes black. Antennæ with segments I, II, and basal portion of III concolorous with body, remaining segments darkening to brown, the last segment black. Legs with femur pale greenish, tibia pale brownish, and tarsus black. Cornicles dusky. Style green.

Wingless viviparous female.—Head and body green, varying from pale to dark. Antennæ a little longer than body; segment VI filament longest, it being from a third to a half longer than III, IV and V subequal, IV, however, invariably slightly the longer, VI base short, it being only about one ninth or one tenth the length of filament; segment III with 24 to 30 irregularly placed circular sensoria which are much more thickly placed on the basal two thirds of the segment; pale green with the joints, distal end of V, and VI blackish. (Pl. 10, fig. 11.) Cornicles cylindrical, concolorous with body, the tip being blackish, reaching to tip of body, twice the length of style and about four fifths the length of antennal segment III. Style concolorous with abdomen.

M. liriodendri Monl. and var. *rufa* Monl.: Davis, Annals, Ent. Soc. Amer. Vol. II (1909), p. 36, figs. I have found this species at Urbana, Galesburg and other central Illinois cities, where it is common on the *Liriodendron tulipifera*. First reported by the writer.

[t]*M. minor* Forbes: 13th Rep. State Ent. Ill. (1884), p. 101. First reported by Forbes.

M. rosæ Linn: Thomas, 8th Rep. State Ent. Ill. (1880), p. 50; Oestlund, Bull. Geol. and Nat. Hist. Surv. Minn. No. 4 (1887), p. 81. A common and annoying pest of garden roses. First (doubtfully) reported by Thomas.

[d]*M. rubi* Kalt.: Thomas, 8th Rep. State Ent. Ill. (1880), p. 64. Supposedly Thomas's observations were made in Illinois, although he does not so state. The species has not since been reported, and is questionable if it occurs in the United States.

M. rudbeckiæ Fitch: Thomas, 8th Rep. State Ent. Ill. (1880),

p. 49; Weed, Psyche Vol. 5 (1889), p. 127. A very common species in Illinois, it being especially noticeable on cultivated lettuce, *Lactuca scariola*, cultivated garden aster, *Aster drummondi*, and *Ambrosia trifida*. First reported by Thomas.

M. sanborni Gil.: Can. Ent. Vol. XXXX (1908), p. 65, figs.; Sanborn, Kans. Univ. Sci. Bull. (1904), p. 73, figs. (*M. chrysanthemi.*) One of the most common and destructive pests of chrysanthemum, both in greenhouses and out-of-doors. First reported by the writer.

**M. solanifolii* Ashm.: Patch, Bull. Me. Agr. Exp. Sta. No. 147 (1907), p. 251, figs. Although not commonly and generally a pest of the potato in Illinois, I have occasionally found it exceptionally and injuriously abundant.

[d]*M. tanaceti* Linn.: Although Thomas mentions this species in the Eighth Illinois report, there is no indication that he actually found it.

**M. tiliæ* Mon.: Bull. U. S. Geol. and Geog. Surv. Vol. V (1879), p. 20. I have taken this rare species on two occasions on the under sides of linden leaves in the Chicago parks.

M. trifolii Perg.: Bull. Div. Ent. U. S. Dept. Agr. No. 44 (1904), p. 21, figs. First reported by Forbes.

M. ulmariæ Schr. (*pisi* Kalt.): Sanderson, Can. Ent. Vol. 33 (1901), p. 31. Common in Illinois on red clover (*Trifolium pratense*), white sweet-clover (*Melilotus alba*), sweet peas and garden peas, it being especially destructive to the two last mentioned. First reported by Thomas.

[t]*M. verbenæ* Thos.: Bull. Ill. State Lab. Nat. Hist. Vol. I, art. 2, p. 8. This species has not been reported since the original collection. First reported by Thomas.

[t]*M. viticola* Thos.: 8th Rep. State Ent. Ill. (1880), p. 55. A common grape louse, often exceedingly abundant. First reported by Thomas. See discussion under *Aphis illinoiensis.*

ADDENDA.

**Rhopalosiphum poæ* Gillette.—Can. Ent. Vol. XL. (1908). p. 61, Figs. 10. Wingless adults, immature and pupæ were found abundant on blue grass (*Poa pratensis*) at Aurora, Ill., November 14, 1910. Found in sheltered places, under conditions almost identical with those reported by Professor Gillette. (*loc. cit.*)

Hyadaphis pastinacæ Linn.—Since writing on this species (see page 493 of the JOURNAL, Vol. 3) Prof. O. W. Oestlund has kindly examined his *Siphocoryne archangelicæ* and in a letter of December 19, 1910, he says that it has the dorsal tubercles and is doubtless the same as *H. salicis* Monl. He further states, "What I take to be a

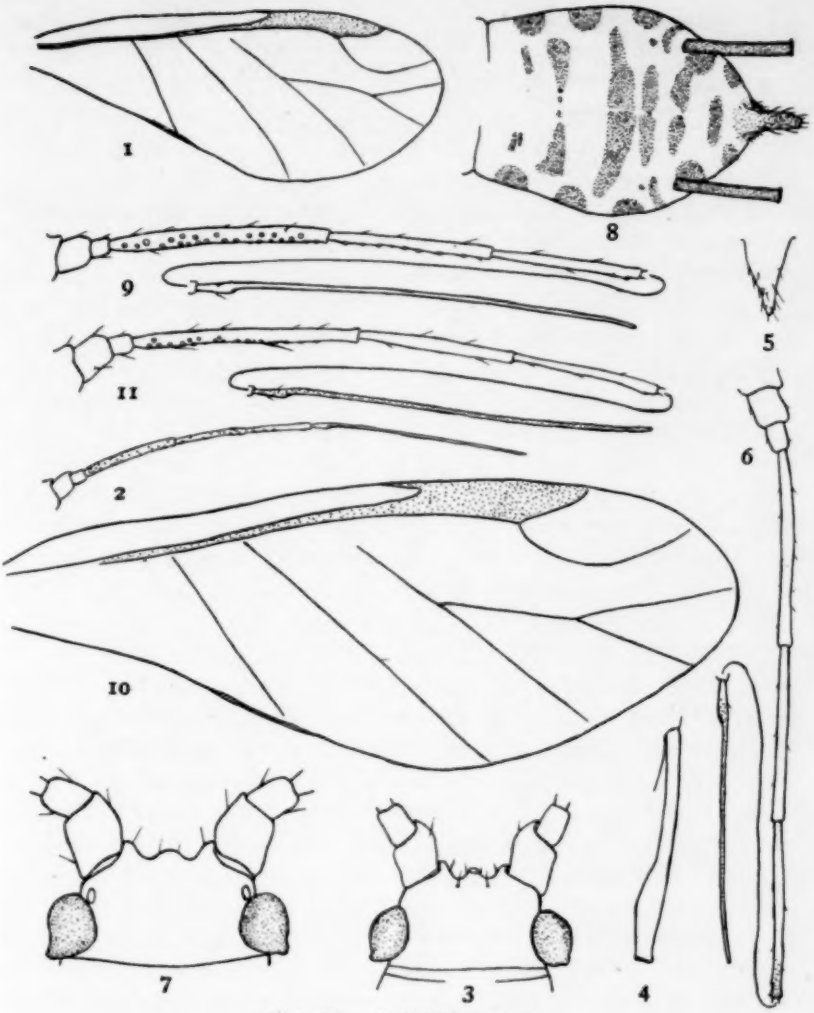


Plate 10. Aphid Structures

typical *S. pastinacæ*, that I collected at Vancouver some years ago, is so similar to our material that the three are no doubt the same.

EXPLANATION OF PLATE 10.

Phorodon galeopsidis Kalt.—Fig. 1, wing; 2, antenna; 3, head; 4, cornicle; 5, style of winged viviparous female.

Macrosiphum cratægi Monl.—Fig. 6, antenna of wingless viviparous female.

Macrosiphum lactucæ Schr.—Fig. 7, head; 8, abdomen; 9, antenna; 10, wing of winged viviparous female; 11, antenna of wingless viviparous female.

Camera lucida drawings, figures 3, 4, 5, and 7, with one-inch eye piece and two-third objective; 2, 8, and 10 with one-inch eye piece and one and a half inch objective; 6, 9, and 11 with a two-inch eye piece and two-third objective; 1 with a two-inch eye piece and one and a half inch objective.

NOTES ON THE EGG-LAYING HABITS AND EMERGENCE OF ADULT OF SANNINOIDEA EXITIOSA SAY

By E. N. Cory, *College Park, Maryland*

In the course of studies of the life history of *S. exitiosa*, several interesting features of the egg-laying habits and emergence of an adult were observed.

The method of procedure in this work was as follows:

Pupæ were collected and bred out in confinement and the moths thus secured were introduced into cages, placed over two-year-old nursery stock. The cages were specially constructed for this work, being large enough to allow the investigator to work within the enclosure. (Pl. 11, Fig. 1.)

The cages were erected in the field on June 22, 1910, but it was not until July 11 that observations were recorded.

Records:

Female No. 1. July 11. At 8.30 a. m. one male and one female moth, number one, bred in confinement, were introduced into cage A. At 9.45 a. m. two more males, bred in confinement, were introduced. No attempt at copulation was made by these males. At 10.10 a. m. one male was observed flying around the outside of the cage near the female, who was resting on the wire with the tip of her abdomen elevated and genitalia protruded. This male was captured and introduced into the cage. He flew at once to the female and copulation began at 10.13 a. m., the pair remaining in coitu until 11.05 a. m. They settled on one of the uprights, with heads in opposite directions.

July 12. All moths caged on July 11 escaped from cage A, owing to a screw pulling loose. This was remedied.

Female No. 2, July 12. At 11.15 a. m. four males and one female, number two, bred in the insectary, were placed in cage A. By 12.15 p. m. four males had visited the cage. Three of these were caught and put into the cage. The female during this time had her abdomen curved upward and the genitalia extended. At 12.23 p. m. copulation took place, but whether with one of the males bred out or one of the visitors, I am unable to say. The female remained stationary as before, the male hovering near until finally able to clasp the female. The two triangular tufts of hairs on the male's abdomen apparently clasped the female along the sides of the abdomen and the anal tuft of the male was above the tip of the abdomen of the female. They remained in coitu until 1. 23 p. m., male head down.

July 13. From 6.30 to 9 a. m. female number two was sluggish and in the grass; from 9 to 11 a. m. she was on the wire of the cage and from

11 a. m. to 3.10 p. m. she was on the peach foliage. At 1.45 she began to gently swing the tip of her abdomen, with ovipositor extended, from side to side, occasionally touching the leaf on which she stood. At 1.56 she deposited her first egg; at 2.09 the second; the third at 2.15 and the fourth at 2.22. She then ceased ovipositing for the day. One male left overnight in the cage.

July 14. At 11.29 a. m. female number two was resting on leaves with genitalia exserted, and one male appeared, which was captured and introduced. At 11.39 a second male appeared at the cage. At 11.51 two more males came to the cage, at the same time the female deposited one egg. At 11.53 one male was allowed to enter the cage and he immediately copulated with female number two, remaining in coitu until 12.44. At 12.46 the female began ovipositing, laying five eggs by 1.01. The remainder of the day she rested on the side of the cage.

July 15. Female number two alive, resting on ground. At 2.30 p. m. she was dead. She deposited twenty-one eggs on the peach leaves. Quite a mass of eggs were in the body, which was mutilated by ants.

Female No. 3, July 13. One female, number three, emerged between 9 and 11 a. m., and was placed in cage B, surrounding four trees, at 11 a. m. At 11.45 she took up a position on a side of the cage, raised her abdomen and extended her genitalia. At 11.56 one male appeared; failed to catch same. At 12.01 p. m. two males appeared; one was caught and placed in the cage. At 12.04 another male appeared; was caught and placed in the cage; at 12.06 a fourth male and at 12.15 a fifth, but neither was caught. At 12.17 female number three copulated with one of the males, remaining in coitu for an hour. At 1.30 the female began ovipositing, two eggs being delivered between 1.30 and 1.40. She then ceased ovipositing for the day. In copulating the male flew at female, waiting with abdomen elevated and genitalia extended, and repeatedly darted the tip of his abdomen at the female, finally joining and turning. The female retained her hold on the cage; the male vibrating its wings rapidly for a time, finally settling on the cage, head down.

July 14. Three males left overnight in cage B. Flight of female heavy. At 3 p. m. female number three began ovipositing again.

July 18. Female number three gone, presumably dead and eaten by ants during the night. She deposited 21, 30, 25, and 85 eggs respectively, on the four trees. Largest number of eggs in one cluster nine; largest number on one leaf twelve.

These results were contrary to any account of the egg-laying habits that the writer had seen and believing that they might be influenced

by the artificial conditions, another condition was supplied in this manner. A peach tree about ten years old having plenty of foliage and a heavy trunk was cut back to permit one of the cages being placed over the tree. This, then approximated natural conditions in every way except that the moth number four was in confinement (Plate 11, Fig. 2).

July 27. All eggs hatched in cage B. The hatching occurred either during the night or very early morning and was not observed; the larvæ emerged from the micropyle end, cutting out the entire end in small sawdustlike particles. Cage B was then moved over four other trees.

Female No. 4, July 25. At 9 a. m. two females, numbers four and five, and one male were put in cage C. At 9.55 two males were flying about the cage, one of which was caught and introduced; at 10.15 a second visiting male was placed in the cage and at 10.22 a third was secured. At 10.24 one pair was in coitu, remaining on the branches and leaves until 11.45 when they separated. At this time female number five, not having copulated, was removed from the cage. In this case, as before, the males appeared only when the female extruded her ovipositor, flying away when she sheathed same. At 1 p. m. two eggs were found on a bark scale just above the ground and one egg about eighteen inches above.

July 26. Female number four not in the cage, presumably died and was eaten by ants. She deposited fifty-six eggs on the leaves and twenty-three on the trunk.

August 4. Seven eggs in cage C hatched between 4.30 p. m. August 3d and 7.30 a. m., August 4th. Larvæ could not be found, even with the aid of a large reading glass.

August 5. Cage C was watched carefully until dark on the 4th, but on visiting the cage at 7.30 a. m. on this date, all eggs were hatched.

Female No. 5. This moth was not used.

Female No. 6, July 27. At 1.30 one female, number six, was introduced into cage B with one male. At 2.10 one male appeared; at 2.15 one male was introduced; at 2.45 another male was introduced and at 2.50 a fourth male was placed in the cage. No copulation.

July 28. At 11 and 11.30 males were placed in cage B. At 11.40 a pair were in coitu, separating at 1 p. m.

July 29. Forty-two eggs on the trunk of one tree in cage B, the first egg eight inches from the ground; last about eighteen inches. Sixteen eggs found on the leaves.

August 1. Female dead. She deposited a total of ninety-seven eggs, forty-two of which were on the trunk and fifty-five on the leaves.

August 1. Eggs on trunk of tree in cage B had their top half eaten

off. A coccinellid (*M. maculata*) found in this cage was brought into the laboratory and placed in a cage with leaves having eggs of *S. exitiosa* on them. The beetle did not eat any of the eggs.

August 1. Nine more eggs in cage B eaten. No insect found that could have done the damage.

August 9. Two eggs in cage B hatched during the time between sunset and 8 a. m. the following morning.

August 10. All remaining eggs in cage B hatched during the interval between sunset and 7 a. m.

Female No. 7, July 28. Female number seven placed in cage A at 10.05 and males placed with her at 11.00, 11.25 and 11.45.

July 29. Twenty-one eggs found in cage A.

August 1. Female number seven dead. She deposited seventy-five eggs, 47 of which were on the tip of one leaf, overlapping both sides.

August 13. No eggs in cage A hatched.

Female No. 8, September 10. Owing to the fact that no more moths emerged in the insectary work was discontinued but on this date two females emerged from the old tree in cage C and on August 12 one of these, number eight, was transferred to cage A. The other was held in reserve.

September 12. One female placed in cage A. At 12 a visiting moth was introduced into the cage and at 12.06 copulation took place, lasting an hour.

September 13. Twenty-two eggs deposited by female. She afterwards became entangled in a spider web and died.

September 29. All eggs in cage A hatched between 6 p. m., August 28, and 9.30 a. m., August 29.

Summary

In all cases, the males appeared only when the females exserted their genitalia and it was notable that the former came to the cages almost immediately following the protrusion of the ovipositor. As far as could be ascertained, no sound was produced by the female. In all cases except one, only the captured, visiting males copulated with the females. In the exception noted, so many males were in the cage that this point could not be determined.

In copulating the females rested on the cage or leaves with genitalia exserted; the male hovered near, darting the tip of his abdomen toward the female until finally able to clasp her genitalia. He then turned with his head in the opposite direction to hers and settled on the same object that supported the female. The shortest period of copulation was fifty-one minutes; the longest eighty-one minutes and the average sixty-five minutes and forty-five seconds. However, in one case the

female was fertilized twice, the day she was introduced and the succeeding day. The time between the fertilization and the oviposition varied between wide limits. In some cases the females oviposited within a few minutes of fertilization, and again the interval was over twenty-four hours.

During oviposition, the female arched the center of her abdomen upward, the tip pointing downward and extended the ovipositor. Then she began to swing her abdomen gently, from side to side, occasionally pausing to touch her ovipositor to the leaf. Each egg was deposited singly and glued to the leaf by a secretion placed on the leaf before delivery of the egg. The eggs are brown, regularly oval, and average .823 mm. x .542 mm. The micropyle end is heavily indented. The shell is net-veined. Plate 11 Fig. 3 shows the eggs, almost natural size, on the leaf. The greatest number of eggs deposited by one moth was 161. The greatest number in one place 147. Of all eggs deposited 390 were placed on the leaves and 65 on the trunk. The shortest period of incubation was 10 days; the longest 16 1-2 days (in September) and the average 13 days. All larvæ emerged from the micropyle end cutting it away in small sawdust-like particles.

Emergence of a Moth

On entering the insectary at 8.30 a. m., July 21, one pupa, collected on July 20 was found half above ground in the flower pot in which it had been placed. Taken into the sunlight at 9 a. m. it began, aft er a few minutes, to twist on the tip of its abdomen as a pivot until about three fourths above ground. After a short rest the insect began pushing upwards by successive contractions and expansions of the abdominal segments until the pupa case split along the back a short distance and down the front between the wing and antennal cases. Continuing the motion the insect gradually withdrew its body. The antennal and proboscis cases split on their inner side, *i. e.*, the side next to the body.

The adult proved to be a male. It rested on a lump of dirt with wings against its sides for several minutes. Wings were then opaque. He gradually arched the anterior wings, separating them from the posterior pair. After having separated them he lowered the anterior pair until in contact with the posterior wings and then raised both sets until their upper surface touched above the back. They were held in this position about five minutes, the opaqueness gradually clearing and the veins becoming outlined with yellow. After five minutes the wings were lowered to the body with the costal margin of the anterior wing at about 45° to the body, in a horizontal plane. After about ten minutes in this position the moth was ready for flight.

Fig. 1.

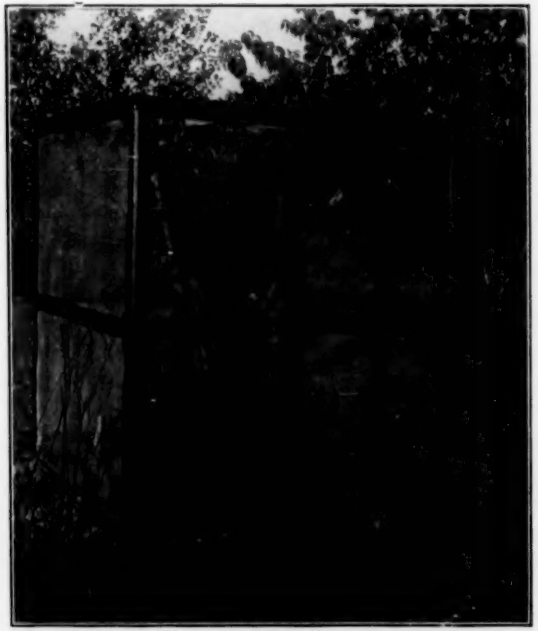


Fig. 2.

Fig. 3.

Fig. 1, large cage over nursery trees; fig. 2, small cage over dehorned tree; fig. 3, leaf showing eggs, slightly reduced

NOTES ON THE RED SPIDER ATTACKING COTTON IN SOUTH CAROLINA[1]

By H. F. WILSON,

Oregon Agricultural College, Formerly Entomological Assistant, Bureau of Entomology, United States Department of Agriculture.

During the spring and summer of 1910 the writer, while an assistant in the United States Bureau of Entomology, worked under the direction of W. D. Hunter, in charge of Southern Field Crop Insect Investigations, at Batesburg, S. C., for the purpose of investigating red spider injury to cotton. At that time *Tetranychus gloveri* Banks was supposed to be the pest in question and a project was planned under that head. Later developments proved that *Tetranychus bimaculatus* Harvey was the real pest. The circumstances which lead to this conclusion will be given below.

With the idea of locating the winter stages of *T. gloveri* a number of procedures were attempted. All evergreens and perennials were examined, the first to find the plants upon which the mites might remain feeding over winter and the second to locate the winter stages about the roots. *T. bimaculatus* was found February 5th in all stages upon the under side of leaves of a bush (*Thea japonica* L.) in a dooryard. A little later in the spring they were found on wild blackberry canes and on cultivated violets. Little attention was paid to this species at that time as *T. gloveri* was supposed to be the pest. By May first, this species not having been located and *T. bimaculatus* being very abundant on a number of weeds as *Chenopodium botrys* and *Datura* sp. as well as on cotton, plans were made to carry on life history work with the second species. These notes cover a period of from May 6 to August 16.

Mites were transferred to potted cotton plants and these were set in the insectary so that other mites could not reach them. From time to time these mites were examined to determine whether they were *T. gloveri*. They were all determined as *T. bimaculatus* by Mr. Nathan Banks of the United States Bureau of Entomology. Single leaves of *Chenopodium botrys* were used to carry on the work as they would not wilt for from twelve to fourteen days when carefully handled. In cases where the leaves wilted it was found that the mites would migrate to fresh leaves and so each vial holding a single leaf was placed in holders which were entirely surrounded with water.

T. bimaculatus began to appear abundantly on cotton in the fields

[1] Published by permission of the Chief of the Bureau of Entomology of the United States Department of Agriculture.

and later investigations throughout the state proved that this species and not *T. gloveri* was doing a great amount of damage. Now the question arises as to which species is really the cotton red spider. My observations show that in 1910 in South Carolina the damage to cotton was altogether by *T. bimaculatus*. In fact that was the only species of Tetranychus found upon any plants.

Regarding *T. bimaculatus*, which I have collected in South Carolina, District of Columbia, Illinois, and Oregon, and which has been reported from Maine, Florida, Colorado, etc., the probability arises that this mite belongs to one of the several common European species. There seems a great likelihood that it has been gradually spread over the United States by greenhouse plants in the southern states, especially by violets, which are favorite ornamental plants for dooryards. They remain green throughout the year and afford a fine winter shelter for the mites. Mr. Banks (Proc. Acad. Nat. Sci., Phila., 1901, p. 596) has, in fact, pointed out that this was probably the way in which the mite was introduced into New Mexico.

The eggs are not deposited in masses on the leaves but usually within a certain area. Oftentimes the female will leave the original starting place and so form two colonies on the same leaf. Probably in every case a web of fine silk-like threads will be found over the eggs with occasional eggs in the web. The eggs when first deposited are like clear drops of water but soon turn reddish and sometimes become dark red. Upon hatching the young mites are colorless, very hard to see, and have but three pairs of legs, the fourth pair appearing after the first molt.

Shortly after hatching the very small mites appear dark green and are so near the color of the leaf that only continued search will reveal them. The first molt takes place in about two days after hatching and after that one can hardly note the molts on account of the presence of the cast skins of the young. There seems to be four molts between eggs and adult. When ready to molt the fourth time the mites are probably full grown and they do not increase in size after molting the last time.

They probably go down to the crown of the plant during cold weather, migrating back to the leaves with the return of rising temperature. From these they migrate to other plants and into cotton fields where they create great havoc in a very short time.

In making notes on life history single females were placed on individual leaves. These records show that in May the length of the egg stage is greater than during the months of June and July, the maximum number of days from deposition to hatching being sixteen and the minimum seven, average thirteen. During June the

maximum was six and the minimum three, average four and one-half. During July the maximum was five and the minimum two, average three and one half. In August two days seemed to be general'y required.

From individual counts it was found that the average number of eggs deposited in May was twenty while in July and August it was twenty-five to thirty.

Very soon after molting the last time the adults began laying eggs and from two to six were deposited each day until toward the last when a day or two passed without eggs being deposited. The life of the adult averaged about fifteen days, a'though one individual lived for twenty-six days. The average time required to reach the adult stage after hatching was twelve days, w'th the maximum twenty-two and the minimum seven.

THE CALIFORNIA CHRISTMAS-BERRY TINGIS

By C. PEMBERTON, *Stanford University, California*

The plant that takes the place in California of the holly of the East, as far as this place can be taken at all, is the so-called Christmas-berry, *Heteromeles arbutifolia*. By the first of December the shrubby bushes of this native plant are laden with firm, bright-red berries which are not at all unlike the holly-berry in appearance and are much used for holiday decoration. But not every year are the berries well developed and bright and in any year not all the bushes are equally strong and fruitful.

Among the causes for these failures of the bushes to reward the berry-gatherer, a small sap-sucking insect is not the least important. This insect may be called the California Chirstmas-berry tingis.

It is probably the same species as the Eastern hawthorn tingis, *Corythuca arcuata*, but it differs from this Eastern form so plainly and constantly by its paler color and disappearing pattern spots that it must certainly be recognized as a distinct variety of the species.

The species is common on hawthorn in the eastern United States and also on the apple and hawthorn in western Washington where it is probably an introduced insect.

The presence of the pest on the Christmas-berry can easily be detected by the brown, sun-burned appearance of the under sides of the leaves. This drying and mottling are due to the punctures and loss of sap and also to the presence of the excrement and dried cast-skins of the nymphal stages. When the attack is a bad one, as it often is

on some of the bushes on the university grounds, the entire foliage is given a brown unhealthy color, strikingly different from the live green of the uninjured plants. There are few Christmas-berry bushes in the Santa Clara Valley that escape the attack of this insect. The pest is also found occasionally and sparingly on the live oak, *Quercus agrifolia*, where the trees are close to Christmas-berry bushes.

The life history and habits of the insect have been studied by me through the present year (1910) and may be described as follows:

The adult female begins egg-laying about the middle of March. This year the first observation of the egg was on March 13. The eggs for the first twenty-five or thirty days are laid in thin groups of from four to eight. They are always laid upon the under surface of the leaf. By the middle of April, however, the vitality of the female seems greater, for eggs are laid in larger numbers. Close, compact groups of from fifteen to twenty eggs, all laid by the same female, are common.

The eggs are whitish and glistening, oval in shape, and average about .3 mm. in length. One end is broader than the other. The egg is deposited on the broad end and inserted upright into the leaf tissue, the broad half being beneath the surface of the leaf and fitting snugly into an incision made by the ovipositor. It is then completely covered by a brown sticky substance which hardens soon after oviposition. The summit of the cone-like mound thus formed is squarely truncate. The top is porous and forms a lid which comes off when the nymph issues. A group of such bodies from which the nymphs have issued look not a little like a number of minature volcanoes with crater-like openings at the top. A careful study was made of the incubation of the egg. It was found to vary from thirty-one to forty-seven days, depending upon the amount of sunlight, wind, temperature, etc. These observations were made upon many groups of eggs in different localities about the University, which were subject to different local conditions.

Nymph, Stage I. The first nymphs seen in 1910 hatched on April 12. They are oval, wingless, of a dirty brown color, and nearly the entire body is covered with short spines. They are very sluggish, not moving from the leaf on which they were hatched, and having a strong tendency to remain close together with their heads pointing toward a central spot. A group of from fifteen to twenty nymphs always actively feeding will discolor a fresh, green leaf in a short time with their excrement and the little white mounds made by the continual puncturing for food.

The nymph moults five times and gradually increases in size from .6 mm. (length of first stage) to 2.6 mm. (length of adult).

The nymph of the first stage is .6 mm. long, by .24 mm. wide. It is ovoid in shape. The legs and antennæ are stout, the legs about one half the length of the body and the antennæ a little shorter. The antennæ are three-segmented and covered with short spines, the third segment being twice as long as the first and second combined.

Each body segment bears on its lateral margin, a long spine, with a heavy conical base, secreting at its tip a transparent viscous fluid. About twenty more of these spines occur on the dorsal surface of the body, distributed as follows: two at the anterior tip, two pairs on the posterior portion of the head and ten or twelve scattered over the dorsal surface of the last five abdominal segments. The facets of the compound eye were always four in number in this stage.

Nymph, Stage II. Length .8 mm., width .53 mm. This stage is much broader in proportion to its length than in the first stage. The legs are slightly less club-like and stocky. The large spines on the dorsal marginal portions of the body have become considerably changed. Their bases have become greatly elongated, are tubular in form and compose over one half the length of the spine. The facets of the compound eye in this stage are five in number.

Nymph, Stage III. Length .96 mm., width .54 mm. The length of the third antennal segment is a little greater in proportion to the combined lengths of the first and second segments than in the preceding stage. The body is slightly longer in proportion to the breadth than in the preceding stage. A small secondary spine has appeared near the base of nearly all the large dorsal and marginal spines. The first and second body segments behind the head are slightly broader and are longer laterally than in the preceding stage. The facets of the compound eye are generally seven in number in this stage.

Nymph, Stage IV. Length 1.5 mm., width .7 mm. The general form is similar to that of the third stage. The antennæ are four segmented, the third segment being a little longer than the fourth which is about the length of segments one and two combined. The antennæ are still about the same length compared with the length of the body, as in stages one, two and three. The prothorax and mesothorax are much broader laterally, each being about three times as broad as long. The spines at the lateral margins of these two segments in this stage are about twice as numerous as in the other segments. The prothorax tapers posteriorly a little. The actual wing pads are first seen in this stage and are modifications of the second body segment posterior to the head. They extend posteriorly to the middle of the second abdominal segment, the posterior extensions being confined to the lateral portions of this segment. The spines are unchanged. The facets of the compound eye are greatly increased in number.

Nymph, Stage V. Length 2 mm., breadth 1.2 mm. The first two segments of the antennæ are equal in length. The fourth segment is equal to the combined lengths of segments one and two. The third segment is a little more than twice the length of the fourth segment. The legs are thinner and longer in proportion to the size of the body than in the preceding stages. The prothorax is half as long as broad, with the median anterior portion elevated. The wing pads extend to the anterior margin of the fifth abdominal segment.

Adult. The adults, male and female, can be easily distinguished without the aid of a lens. The tapering, bluntly-pointed abdomen of the male distinguishes it readily from the regularly rounded abdomen of the female. Another very distinctive feature of the male abdomen is the presence of a pair of large forcep-like claspers situated at the posterior tip.

The ovipositor of the female is concealed in a short, longitudinal groove on the under side of the abdomen at the posterior tip. The sides of the eighth abdominal segment overlap it, almost concealing

it. The ovipositor consists of a basal pair of plates joined along their inner edges and forming a sheath for the two cutting blades which are serrated on the outer edges, and adapted for cutting the leaf tissues, preparatory to the deposition of the egg.

Here in the Santa Clara Valley the adults hibernate only for a short period, depending upon the severity of the winter. They hibernate about the food plant under fallen leaves, under sticks, clods, stones, etc., and in secluded places on the trees such as curled leaves and cracks in the bark. They are not active upon the tree until about the middle of February. They then come out in considerable numbers and feed, usually in pairs, upon the under surface of the leaf. This year (1910) the first appearance of the adult was February 16. It is particularly interesting to note that this insect always feeds on the under surface of the leaf. Adults placed on the upper surface always move to the under surface im nediately. The adults very seldom fly, and hardly ever leave a small branch on which they are feeding. They usually attack that portion of a tree most exposed to sunlight and are particularly common on the young new shoots about the base of the tree.

Broods. There are several broods in a year though it has not been determined whether the number is definite or whether it varies, according to climatic conditions. Under normal conditions here in the Santa Clara Valley the average life cycle is passed in about seventy-eight days. As the period of activity lasts about eight months, it seems very probably that there are but three broods a year. The greatest activity is in the summer months. By the first of November this year (1910) egg-laying had ceased, and at present (December) very few nymphs can be found while most of the adults have either died or hibernated.

A record was kept on several groups of nymphs to determine the duration of each stage. The average results were as follows:

Time elapsed between hatching of

Egg to 1st moult	8 days.
1st moult to 2d moult	6 days.
2d moult to 3d moult	7 days.
3d moult to 4th moult	7 days.
4th moult to 5th moult	11 days.

Injuries. As before stated the damage to the bush is considerable, but seems never fatal. About the university, probably much more damage to this bush results indirectly from the attack of the tingis, for a black smut or fungus (*Capnodium heteromeles*), the spores of which readily grow in the honey-dew excreted in large quantities by

the nymph, gains a strong foothold on most of the bushes and almost smothers them.

Remedies. The only remedy that can be given from actual observation here is that of intensive cultivation and cleaning up of rubbish about the bases of the trees during the period of hibernation, from December to March, of the adult. Trees about the university which have received little or no cultivation for the past two years were usually much more vigorously attacked by the tingis than those receiving regular winter cultivation. Where spraying has been attempted, success has resulted from the spraying of kerosene emulsion freely on the foliage, using an under spray nozzle.

This paper was prepared in the Entomological Laboratory of Stanford University.

EXPLANATION OF PLATES 12–14

Fig. 1. Egg on surface of leaf.
2. Same with portion of covering removed.
3. Same removed from leaf showing secondary covering (a).
4. First stage of nymph.
5. Second stage of nymph.
6. Third stage of nymph.
7. Fourth stage of nymph.
8. Fifth stage of nymph.
9. Adult.
10. Labrum of adult.
11. Mandible of adult.
12. Maxilla of adult.
13. Labium of adult.
14. Ventral aspect of last two abdominal segments of male. (a) clasper.
15. Ventral aspect of last three abdominal segments of female. (b) ovipositor.
16. Ovipositor removed—lateral view.
17. Cutting blade of ovipositor removed—lateral view. (c) cutting edge.
18. Wing of adult.

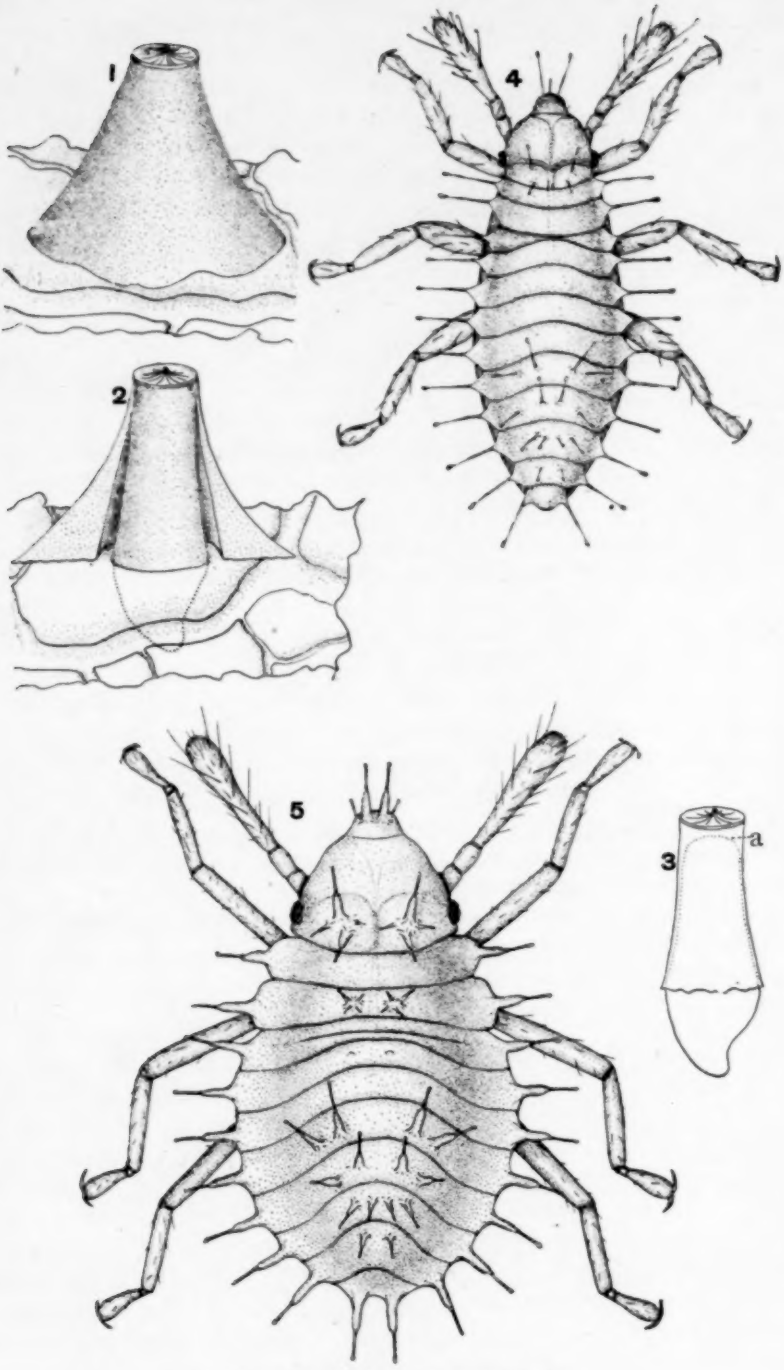


Plate 12. Christmas-berry Tingis

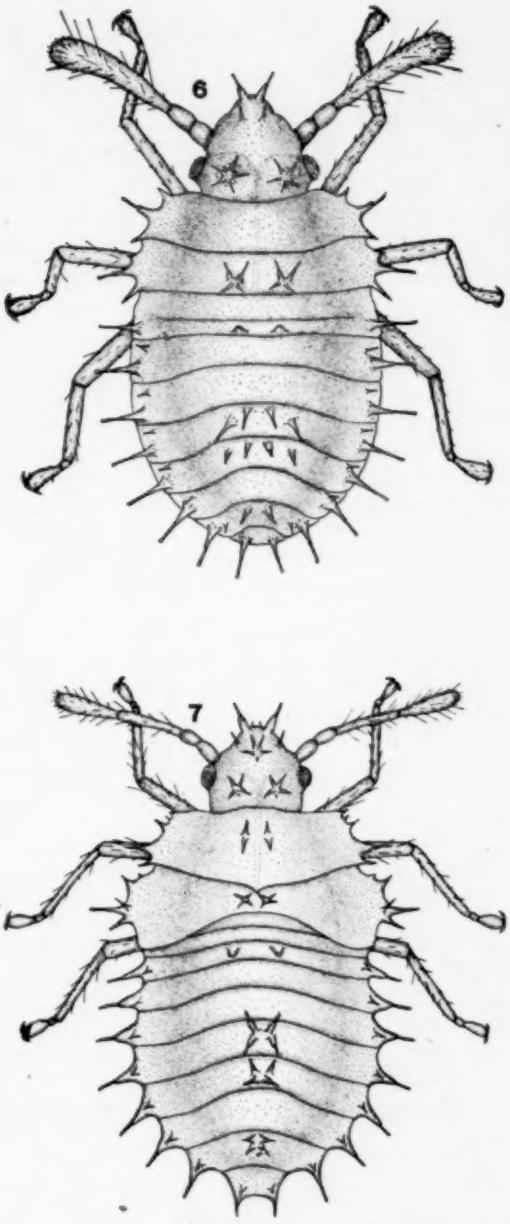


Plate 13. Christmas-berry Tingis

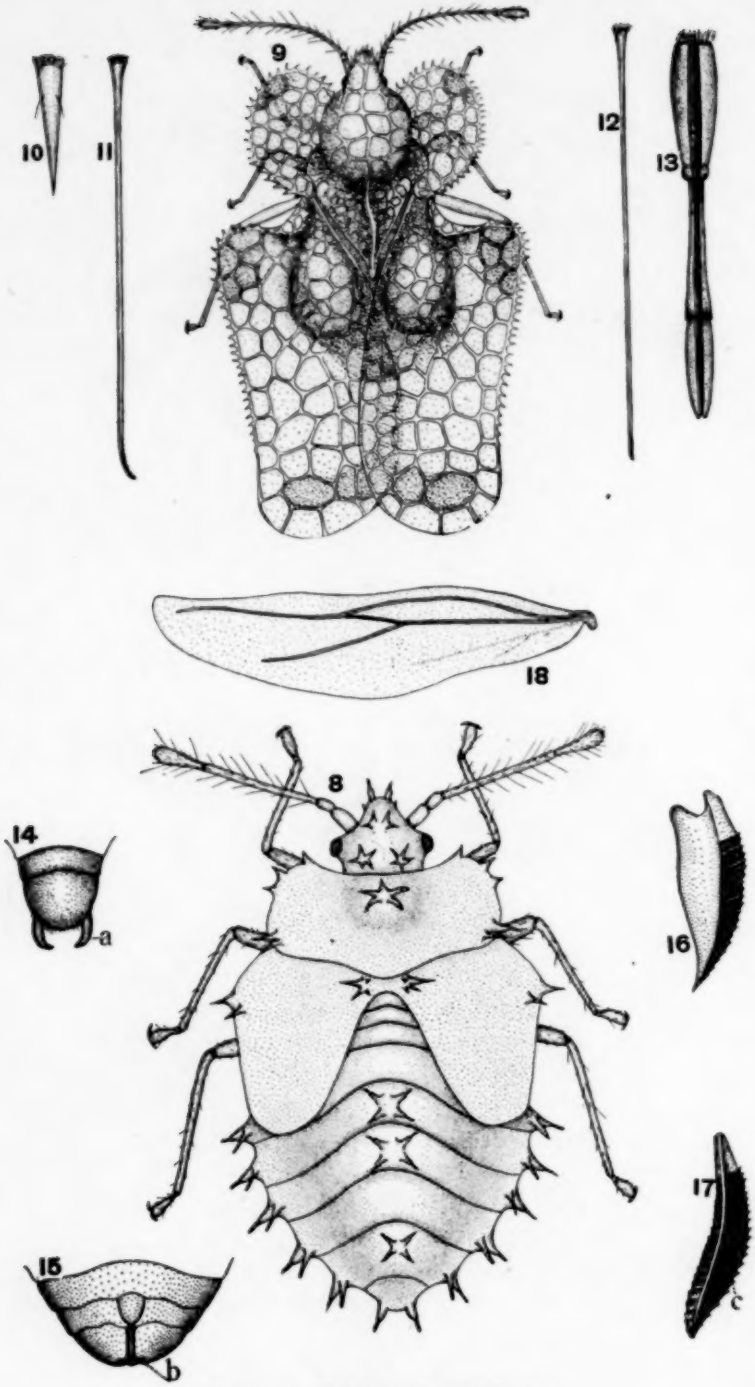


Plate 14. Christmas-berry Tingis

RHOPALOMYIA GROSSULARIÆ n. sp.

By E. P. FELT, *Albany, N. Y.*

The form described below was reared from deformed gooseberry buds, *Ribes grossularia*, in May, 1911, by J. S. Houser of the Ohio Agricultural Experiment Station. The material was collected at Camp Chase. An economic discussion of this species will be given by Mr. Houser. This form, in antennal characters, approaches the North American *Rhopalomyia tridentata* Rubs. reared from Artemisia, though it is easily distinguished therefrom by the uniarticulate palpi.

Description: *Male*. Length 1.8 mm. Antennæ extending to the third abdominal segment, rather thickly haired, fuscous yellowish; 16 segments, the fifth having a stem with a length about one half the subcylindric basal enlargement, which latter has a length one half greater than its diameter, a rather scattering subbasal whorl of short setæ and a thick subapical band of longer, curved setæ; terminal segment reduced, narrowly oval. Palpi composed of one short, incrassate segment. Mesonotum shining dark brown, the submedian lines fuscous yellowish. Scutellum yellowish orange, postscutellum and the base of the first abdominal segment shining dark brown. Abdomen sparsely haired, dark reddish brown; genitalia fuscous. Wings hyaline, costa light straw. Halteres fuscous yellowish, somewhat reddish basally. Coxæ reddish brown; femora, tibiæ and tarsi a fuscous straw, the distal tarsal segments somewhat brownish; claws rather long, moderately stout, evenly curved, simple, the pulvilli as long as the claws. Genitalia; basal clasp segment moderately long, broad; terminal clasp segment short, swollen, toothed apically; dorsal plate long, broad, triangularly incised, the lobes irregularly and roundly tapering, rather thickly setose; ventral plate long, moderately broad, deeply and roundly emarginate, the lobes irregularly rounded and sparsely setose. Harpes short, stout, truncate and with sparse subquadrate teeth posteriorly at the internal angle and the external third; style moderately long, stout, subtruncate.

Female. Length 2 mm. Antennæ extending to the third abdominal segment, sparsely haired, reddish brown, the distal segments reddish; 16 segments, the fifth with a short stem, the subcylindric basal enlargement with a length one half greater than its diameter, a moderately thick subbasal whorl of short setæ and a subapical band of longer, slender setæ; terminal segment somewhat reduced, irregular. Palpi composed of one irregular, slightly swollen, thickly setose segment. Mesonotum shining dark brown, the submedian lines sparsely haired. Scutellum a variable fuscous yellowish, postscutellum dark brown. Abdomen deep red; ovipositor fuscous yellowish. Halteres yellowish basally, slightly fuscous apically. Ovipositor when extended with a length about equal to that of the abdomen, the terminal lobes with a length over twice the width, narrowly rounded apically and thickly setose; minor lobes short, setose. Other characters practically as in the male.

Type Cecid a2173, N. Y. State Museum.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1911

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

Verify and investigate. Test the old and work out the unknown. This is the keynote to applied entomological activity. The first is hardly less important than the second. There is still too much tradition current as truth, and some of these unproved, though accepted statements, concern matters having a vital relation to control measures. It is a most hopeful sign of the times that so many real contributions to entomological knowledge are appearing. They range from popular bulletins based on recent studies of serious pests to almost entirely original discussions of new forms of injury by obscure species. We now have a series of publications which may well be accepted as standards for similar work with other species or groups. The end of such endeavor is by no means in sight. The studies of recent years have resulted in the accumulation of many facts necessitating a revision of our ideas respecting certain groups and opening up many interesting and also most practical lines of investigation. Some of these studies may not appear to have an immediate practical importance, nevertheless progress along substantial lines depends in large measure upon the continuance of just such apparently theoretical investigations, since a broad knowledge of biology in its various bearings is an essential preliminary to the best practical work.

It is unfortunate that the common name "locust" has been applied to such widely divergent insects as grasshoppers and the periodical cicada. The result is frequently amusing. Some months ago we read an article in a popular magazine discussing the South African grasshopper or locust situation. This notice was illustrated by a series of excellent figures showing the periodical cicada. The latest appears in a fruit paper in which one of our younger entomological friends writes: "It is quite difficult to prevent the locusts or grasshoppers from depositing their eggs in the young shoots of fruit trees

. . . " There is more to the same effect. We presume that the notice was prepared hurriedly. This confusion of ideas could be prevented by adhering and leading the general public to adopt a rational nomenclature for common names. An excellent start has been made and we trust that the effort will be continued till such absurdities are eliminated. Our English brethren recognize the desirability of this, and it is not too much to hope for world-wide coöperation in this respect.

Reviews

The Codling Moth, by L. CAESAR. Ont. Dep't Agric., Ont. Agric. Coll. Bul. 187, p. 1–40. 1911.

An excellent, comprehensive, popular account, based on original observations in Canada and written with special reference to conditions obtained in the Ontario region. There is an admirable series of observations on the transformations of the larva, pupation and appearance of the moths. The discussion of spraying outfits is practical. The author very justly emphasizes the importance of thoroughness in spraying for this insect. While admitting the desirability of throwing the poison into every calyx, we are not quite willing to affirm this as a cardinal necessity, providing the distribution is thorough. We have repeatedly seen spraying where practically every leaf and blossom end was poisoned with very little penetration to the inner calyx cavity and no dripping, yet 95 to 98% of the fruit was free from worms. The record of results following one application is particularly gratifying, the author finding that the sound fruit ranged from 80 to 98% or an average of 90%. There is an excellent series of illustrations. This publication should do much toward making matters plain for the fruit grower.

Fourth Annual Report of the Committee of Control of the South African Central Locust Bureau, CHARLES P. LOUNSBURY, Editor, p. 1–60. 1910.

The record of coöperation in locust control among the South African colonies is continued in this report. One of the most interesting facts is possibly the demonstration that locust eggs, under certain conditions, may retain their vitality for three and one half years. American entomologists confronted by local grasshopper or locust problems will find valuable suggestions in the discussion of poisons. A sweetened preparation of arsenite of soda was largely used for the destruction of these insects, it being either sprayed upon the vegetation or applied as a poisoned bait. This latter should preferably be vegetable matter cut fine and widely distributed, since this procedure greatly lessens the danger of poisoning stock. There have been several cases of the latter in South Africa, all, or nearly all, due to gross carelessness in this respect. The value of this report is greatly enhanced by colored plates illustrating the two important species, and also a series of maps showing the distribution of the insects in both the adult and immature stages.

Tests of Sprays against the European Fruit Lecanium and the European Pear Scale, by P. R. JONES. U. S. Dep't Agric., Bur. Ent. Bul. 80, Prt. 8, p. 149–60. 1910.

This publication is of special value to the economic entomologist, since it gives details of field tests against *Lecanium corni* Bouché and also *Epidiaspis pyricola* Del Guer. The author finds that winter treatments with five or six per cent distillate oil emulsion with and without caustic soda, and a twelve per cent crude oil emulsion are effective in controlling both of these pests without injury. Caustic soda and creosote oil emulsion sprays, while effective in destroying the insects and lichens, are also injurious to the trees. Several excellent illustrations add greatly to the value of this publication.

Medullary Spots: A Contribution to the Life History of Some Cambium Miners, by J. G. GROSSENBACHER. N. Y. Agric. Exp't Sta. Tech. Bul. 15, p. 49–65. 1910.

This records the discovery of *Opostega nonstrigella* Chamb. as a cambium miner in currants. The study shows this species to be capable of causing direct injury and also, as a result of its operations, facilitating serious fungous infection. The various stages of the insect are described, the original account of the moth reproduced and our knowledge of European species summarized. There is an excellent series of illustrations. The author is to be congratulated on having discovered the larva in this country.

The Smoky Crane-Fly, by JAMES A. HYSLOP. U. S. Dep't Agric., Bur. Ent. Bul. 85, Prt. 7, p. 119–32. 1910.

This paper records serious injury to Japanese clover, *Lespedeza striata*, in Tennessee by the smoky crane-fly, *Tipula infuscata* Loew. The life history and habits of this species are carefully worked out and a summary given of the more important records of injury by Tipulid larvæ. There is also a list of birds, compiled from the records of the Bureau of Biological Survey, known to feed to a greater or lesser extent upon the Tipulidæ or their eggs. This bulletin, with its admirable series of illustrations, forms an excellent basis for further studies in this group.

The Control of the Argentine Ant, by C. W. WOODWORTH. Cal. Agric. Exp't. Sta. Bul. 207, p. 53–82. 1910.

This is a well illustrated bulletin discussing the Argentine ant and other Formicidæ. It is somewhat technical in that it gives keys to subfamilies and genera and lists the species found in California. The admirable series of illustrations and the keys will be very helpful to students of the California fauna. The author states that there are in California about forty colonies of the Argentine ant distributed over some 5,000 acres. Under control measures he gives prominence to the excluding of the pests and ant-proof construction. The use of carbon bisulfid, a solution of potassium cyanide or a sweetened arsenical preparation is advised for the destruction of these pests.

Some Common Bag Worms and Basket Worms, by CLAUDE FULLER. Natal Dep't of Agric., Bul. 16, p. 1–11. 1909.

The natal bag worm fauna, judging from the acocunts, is a most interesting one. This publication is a popular discussion of Psychidæ larvæ with observations upon a number of species. Unfortunately, the latter are designated only by common names. The excellent illustrations add greatly to the value of this contribution to entomological knowledge.

Current Notes

Conducted by the Associate Editor

The Peruvian government has extended the contract of Mr. C. H. T. Townsend, as Entomologist of State, to December 31, 1912, at a substantial increase of salary. Mr. Townsend expects to conduct extended work with parasites and predaceans during the next two years against the white scale of cotton (*Hemichionaspis minor*), the cotton-square weevil (*Anthonomus vestitus* or n. sp.), and several other important cotton insects in Peru. Measures are under way to establish a cotton insect laboratory at Piura, with an area of growing cotton for experimental purposes attached, and to secure a trained assistant from North America who can qualify for research work on pests and parasites. Mr. Townsend's address will continue to be Piura (Piura), Peru, South America.

Mr. John J. Davis has resigned his position with Prof. S. A. Forbes, state entomologist of Illinois, and is now connected with the Bureau of Entomology. His work is especially on *Lachnosterna* and *Aphididæ*, under Prof. F. M. Webster, and his headquarters for the present will be at the Agricultural Experiment Station, Lafayette, Ind.

Mr. D. K. McMillan of the Bureau of Entomology, who has been stationed at Brownsville, Texas, and engaged in truck crop investigations, has resigned to accept a position with Prof. S. A. Forbes in similar work in Illinois. His entomological friends and associates gave him a farewell dinner on March 8, according to *Entomological News*.

Fred E. Brooks has resigned as associate entomologist of the West Virginia Agricultural Experiment Station to take up work with the Bureau of Entomology. Mr. Brooks will have charge of investigations of certain fruit insects throughout the Appalachian region under the direction of Professor Quaintance. His field station will be at French Creek, W. Va.

Mr. Walter S. Abbott, assistant in entomology at the New Jersey Agricultural Experiment Station, resigned March 1 to accept an appointment as assistant in charge of collections, records and insectary at the Agricultural Experiment Station of Illinois at Urbana, under Prof. S. A. Forbes.

Prof. William B. Alwood, formerly state entomologist of Virginia, now of the Bureau of Chemistry, sailed April 13 for Gibraltar. He will investigate the viticultural conditions of Southern Europe and attend the International Agricultural Congress at Madrid.

At the University of California, work has commenced on the new agricultural building, which will be constructed of white granite and will be 162 by 64 feet in size. The entomological department will have quarters on the second floor of this building.

The Alabama legislature has just appropriated to the Experiment Station $26,800 annually, of which $2,300 is for combatting the cotton boll weevil and other injurious insects.

William H. Dean, Jr., formerly of the Bureau of Entomology, has been appointed assistant entomologist of the Texas Agricultural Experiment Station.

Mr. E. E. Scholl has resigned as instructor in entomology at the Agricultural and Mechanical College, College Station, Texas.

Mr. R. E. Snodgrass has resigned his position with the Bureau of Entomology.

Dr. Samuel H. Scudder of Cambridge, Mass., the veteran author of the monumental three-volume work on the Butterflies of the Eastern United States and Canada, and well known for his classic works on the Orthoptera and fossil insects, died May 17, at the age of seventy-four years.

Col. William Gorgas of the United States Army, who has had charge of several sanitary crusades, especially in doing away with mosquito breeding places in localities where yellow fever is prevalent, was honored by Tulane University with the degree of Doctor of Laws.

It is gratifying to note that George Washington University has conferred the honorary degree of M. D. upon the highly esteemed chief of the United States Bureau of Entomology, Dr. L. O. Howard. This is not only a recognition of the abilities of the man, but is striking testimony to the standing economic entomology is beginning to hold in the estimation of the medical profession.

We learn through the *College Signal* of the Massachusetts Agricultural College, that A. H. Kirkland, well known to entomologists because of the prominent part he took in gipsy and brown-tail moth work in Massachusetts, is now in Utah for special service in connection with the United States Bureau of Entomology investigation of the alfalfa weevil.

A notice just at hand states that Charles P. Lounsbury, entomologist, Cape Town, Cape of Good Hope, South Africa, has become chief of the Division of Entomology, Union Department of Agriculture, Pretoria, South Africa. We trust that this means promotion and an enlarged field for one who has made an enviable record in a country distant from entomological centers.

We learn through Dr. L. O. Howard, chief of the Bureau of Entomology, United States Department of Agriculture, that Mr. D. Van Hove has been appointed entomologist for Belgium, the information being transmitted by the American consul at Ghent, through the Secretary of State and Secretary of Agriculture.

The Minnesota State Legislature, at its last session, appropriated six thousand dollars for two years' work against grasshoppers under the direction of the State Entomologist. Grasshoppers were injurious in 1909 and 1910, destroying at least two thirds of the flax crop of the state. Three or four men are already in the field at different points of the Red River valley, aiming to discover some method or methods by which the individual farmer can protect his crops from these insects.

Mailed June 22, 1911.